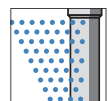


## Technical Reference Manual LFXG-D®

FiberFlex® Detector with GEN2000®  
Electronics for Foundation Fieldbus®  
Applications Measuring Continuous Level



Document ID:  
31400





## Revision history

Table 1: Revision history

Version	Description	Date
1.0	Initial release. Formerly 241158.	051201
1.1	Electronics revision	090306
1.2	Added certification information and IECex label	090819
1.3	Changed company name, logo, and website	110301

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ISO 9001 approval by Lloyd's Register Quality Assurance Limited, to the following Quality Management System Standards: ISO 9001:2000. ANSI/ASQC Q9001-2000. Approval Certificate No. 107563.

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### **WARNING**

Use this equipment only in the manner that this manual describes. If you do not use the equipment per VEGA specifications, the unit is not CE compliant, and may be damaged or cause personal injury.

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# Explanation of symbols




Table 2 lists the symbols that the manual and instrument use.

Table 2: Explanation of symbols

In the manual:

	<b>Radiation notice</b> Information concerning radioactive materials or radiation safety information is found in the accompanying text.
	<b>Caution</b> Warnings concerning potential damage to the equipment or bodily harm are found in the accompanying text.

On the instrument:

	<b>AC current or voltage</b> A terminal to which or from which an alternating (sine wave) current or voltage may be applied or supplied.
	<b>DC current or voltage</b> A terminal to which or from which a direct current voltage may be applied or supplied.
	<b>Potentially hazardous voltages</b> A terminal on which potentially hazardous voltage exists.





# Foundation Fieldbus system

In order to use the level gauge you must install and configure the Foundation® Fieldbus system.

Using VEGA's Foundation fieldbus device description (DD), you can view or edit the variables in VEGA's Foundation fieldbus gauge transducer block in two of the following ways:

- Use the transducer block variable list directly
- Use menus provided by VEGA's DD

The menu structure in VEGA's DD provides an easier access to the variables. Under the menus, the variables are separated by functions, such as:

- Setup parameters
- Information parameters
- Calibration parameters

**Note:** Not all host systems support this menus capability. If your host does not support menus but does support methods, refer to the host software documentation to find out how to execute the methods.

Methods are short procedures that manipulate multiple variables in order to perform a specific function (such as calibration or linearization). Methods provide a simple, organized procedure for these functions. VEGA's Foundation Fieldbus Device Description (DD) includes many methods to help setup the gauge.

Throughout this manual, when a procedure is given that references the menus interface, the name of the corresponding method is also provided so that if the host does not support menus, you may be able to find the method by name.

On some host systems, when these methods are executed, you may experience a long delay (three to four minutes) before the method is actually run. This delay is caused by the host system, which is reading all parameters of the gauge (over 200 of them) before executing the method. The procedures in this manual describe both methods of viewing and editing transducer block variables.



## User's comments

VEGA values your opinion! Please fill out this page so that we can continually improve our technical documentation.

Manual: LFXG-D Technical Reference Manual

Date: \_\_\_\_\_

Customer Order Number: \_\_\_\_\_

How we can contact you (optional if you prefer to remain anonymous):

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Did you find errors in this manual? If so, specify the error and page number.

Did you find this manual understandable, usable, and well organized? Please make suggestions for improvement.

Was information you needed or would find helpful not in this manual? Please specify.

Please send this page to:

VEGA Americas, Inc.  
Director of Engineering  
4241 Allendorf Drive  
Cincinnati, OH 45209-1599



## Customer Service

VEGA has Field Service Engineers or Radiation Safety Officers available for onsite service, emergency services, or equipment start up.

Contact Information	Telephone Number
Monday through Friday 8:00 A.M. - 5:00 P.M. EST (Eastern Standard Time)	1-513-272-0131
Emergencies: Follow the voice mail instructions	1-513-272-0131
Fax	1-513-272-0133

---

▪

## Have this information ready

- VEGA Customer Order (C.O.) Number located on the source holder's engraved label
- Sensor's serial number
- Located on the gauge's housing inside the external housing



# Chapter 1: Introduction

---

## Nuclear materials notice

This equipment contains radioactive source material that emits gamma radiation. Gamma radiation is a form of high-energy electromagnetic radiation. Only persons with a specific license from the U.S. NRC (or other regulating body) may perform the following to the source holder:

- Dismantle
- Install
- Maintain
- Relocate
- Repair
- Test

VEGA Field Service engineers have the specific license to install and commission nuclear gauges, and can instruct you in the safe operation of your density gauge. To contact VEGA Field Service, call 513-272-0131. Users outside the U.S. and Canada may contact their local representative for parts and service.



**Note:** See the *Radiation Safety for U.S. General and Specific Licensees, Canadian and International Users* manual and the *Radiation Safety Manual Addendum of Reference Information* CD that came with the source holder and the appropriate current regulations for details.

## Unpacking the equipment



### CAUTION!

You must be familiar with radiation safety practices in accordance with your U.S. Agreement State, U.S. NRC, or other nuclear regulatory body before unpacking the equipment.

- ☑ Unpack the unit in a clean, dry area.
- ☑ Inspect the shipment for completeness by checking against the packing slip.
- ☑ Inspect the shipment for damage during shipment or storage.
- ☑ If the detector is included as a separate package in the shipment, inspect the assembly for damage. If damaged, file a claim against the carrier and report the damage in detail. Any claim on VEGA for shortages, errors in shipment, or other problems must be made within 30 days of receipt of the shipment.
- ☑ If you need to return the equipment, see page 107 for information concerning returning equipment for repair.
- ☑ After you unpack the equipment, inspect each source holder in the shipment to ensure that the source holder is locked.



**Note:** Most source holder models accept a lock. Call VEGA Field Service immediately for further instructions if:

The source holder does accept a lock and there is no lock on it.

- The lock is not secured.
- You cannot secure the lock.
- The operating handle does not properly move into the OFF position.

See the ***Radiation Safety for U.S. General and Specific Licensees, Canadian and International Users*** manual and the ***Radiation Safety Manual Addendum of Reference Information*** CD that came with the source holder and the appropriate current regulations for details.



## Storing the equipment

### Storing the source holder

If it is necessary to store the source holder, do so in a clean, dry area. Be sure the source holder shutter is in the OFF or CLOSED position. Check the current local regulations (U.S. NRC, Agreement State, or other) to determine if this area must have any restrictions.

### Storing the gauge

Avoid storage at temperatures below freezing. Store the gauge indoors in an area that has temperature-control between 10 °C and 35 °C (50 °F and 95 °F) and less than 50% relative humidity. Store equipment in dry conditions until installation.

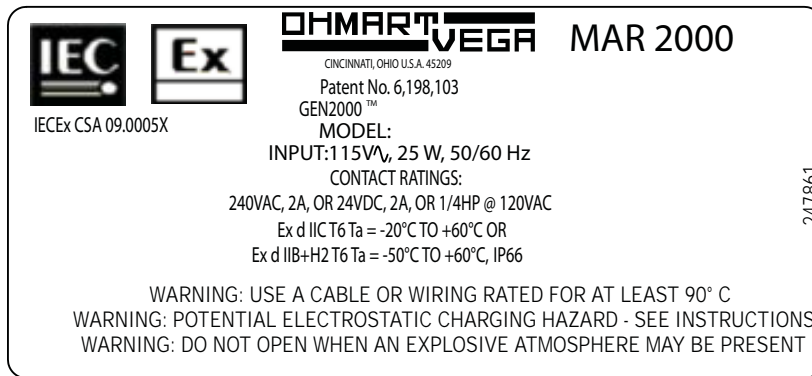
## Certifications

This gauge is designed for certification compliance from the following agencies:

- ATEX Standard
- CCOE (India)
- CEPEL/INMETRO (Brazil)
- CSA
- FM Standard
- GOST-B Standard
- GOST-R Standard
- IECex
- JIS (Japan)
- KTL (Korea)
- NEPSI (China)

## Safety Information for EX Areas

Please note the EX-specific safety information for installation and operation in EX areas.



*Figure 1: IECEx Label*

# LFXG-D specifications

Table 3: LFXG-D specifications

System Accuracy	±1% of span typical	Accuracy depends on specific application parameters
Active Lengths	Flexible detector	305–7,010mm (12–276") in 305mm (12") increments
Typical Sources	Cesium-137	0.66MeV gamma radiation emitter, 30.2 year half life
	Cobalt-60	1.2 & 1.3MeV gamma radiation emitter, 5.3 year half life
Power Requirements*	AC	90–254VAC at 50/60 Hz, at 15W (without heater) or 25W (with optional heater) maximum power consumption. CE compliance requires 100–230 ±10% VAC. The fieldbus gauge uses 0.3W of power from the fieldbus power supply.
	DC	20–60VDC (less than 100mV, 1/1,000 Hz ripple) at 10VA CE compliance requires 24VDC±10%
	Wiring	Type A—1.02mm (#18AWG) or Type B—(#22AWG) with insulation suitable for at least 250V.
Signal Cable	Maximum length	Type A—1,900m (6,232'). Type B—1,200m(3,936')
	FB signal	1.02mm (#18AWG) shielded, twisted pair Type A—1.02mm (#18AWG) or Type B—(#22AWG) with insulation suitable for at least 250V.
GEN2000® Electronics Housing	4-wire hookup with DC	1.02mm (#18AWG) four conductor shielded
	Safety information for EX areas	This equipment is suitable for use in the following environment: <ul style="list-style-type: none"> <li>• CSA Class I, Div 1, Groups A, B, C, &amp; D</li> <li>• CSA Class I, Div 2, Groups A, B, C, &amp; D</li> <li>• CSA Class II, Div 1, Groups E, F, &amp; G</li> <li>• CSA Class II, Div 2, Groups E, F, &amp; G</li> <li>• ATEX Certificate #112 G/D EEx d IIC TP6 IP66 -20 °C ... +60 °C or II2G EEX d IIB+H2 T6 -50 °C ... +60 °C</li> <li>• NEMA Type 4X IP66</li> <li>• Non-hazardous locations</li> </ul>
	Ambient temperature	–20 °C ... 60 °C (–4 °F ... 140 °F) option for lower temperatures available
	Humidity	0–95%, non-condensing
	Vibration	Tested to IEC 68-2-6, IEC 68-2-27, and IEC 68-2-36
	Material	Cast aluminum ASTM A 357
	Paint	Polyester Powder Coating
	Weight	Housing detector 0.0015xLength(mm)+5.44kg (0.084xLength(inches)+12lb)
Relay Output	Software user-settable	Diagnostic alarm or process high/low alarm function
	Rating	6A at 240VAC, or 6A 24VDC (SPDT Form C), or 1/4HP at 120VAC
Fieldbus® Communication	Fieldbus Protocol	Foundation Fieldbus communication protocol
Auxiliary Input Capability	Type	Frequency input (0/100 kHz)
	Possible function	Optional NORM or vapor phase compensation, multiple gauge linking, & others
Electronics	On-board memory	FLASH and two EEPROMs
Diagnostics	LED indication	+6V, Memory Corruption, CPU Active, Auxiliary, High Voltage, Relay & Field Strength

- Power specifications change to 115VAC or 230VAC if an internal heater kit is used. For more information, see page 109.

# Typical applications

VEGA level gauges accurately indicate the level of liquids or bulk materials throughout a range on vessels, reactors, or tanks.

In order to achieve a level indication over the desired length, it may be necessary to use more than one detector. The way these multiple detectors link together depends upon the types of detectors used. Specific details on using multiple detectors are available from VEGA Americas, Inc.

The accuracy of quality control systems that use VEGA nuclear level gauges is profitable to a wide range of industry operations. A number of applications that use a level gauge are:

## Pulp and Paper

- Liquors
- Bleach plant chemicals
- Coating chemical storage
- Lime mud
- Wastewater treatment tanks

## Chemical

- Low pressure/low vapor chemical storage
- Settlers
- Surge tanks

## Food and beverage

- Food slurries
- Pastes
- Syrups
- Dough level
- Intermediate batch storage

## Water and wastewater

- Settling/aeration tanks
- Clarifiers
- Sludge holding tanks
- Wet wells

## Where to find help

If you need help finding information, check the Index and Table of Contents within this manual. In addition, the fieldbus software has HELP screens. These help screens are useful references for definitions of parameters and hints.

## VEGA Customer Service

VEGA Customer Service has Field Service Engineers located across the U.S. for on-site service to U.S. and Canada. In many cases, a Field Service Engineer is at your plant for the start up of your gauge. In addition, Field Service Engineers regularly assist customers over the phone.

If you have a question or need help, call Customer Service during office hours. If your problem is an emergency (for example, a line shut down because of VEGA equipment), you can reach us 24-hours a day.

*Table 4: Contact information*

Contact Information	Telephone Number
Monday through Friday 8:00 A.M. - 5:00 P.M. EST (Eastern Standard Time)	1-513-272-0131
Emergencies: Follow the voice mail instructions	1-513-272-0131
Fax	1-513-272-0133

In addition, VEGA provides field service for customers outside the U.S. and Canada. Customers outside the U.S. and Canada can also contact their local VEGA representative for parts and service.

When calling with a question, if possible, please have the following information ready:

- ☒ VEGA Customer Order (C.O.) Number—Location on the engraved label on the source holder
- ☒ Sensor serial number—Location on the sensor housing inside the external housing

## Principle of operation

VEGA's continuous level gauge is a nuclear gauge that receives a shaped or collimated beam of radiation, through the process material, from the source holder. The material in the vessel acts as a shield that prevents a portion of the detector from exposure to the radiation field. As the level decreases, the detector senses more radiation. As the level increases, the detector senses less radiation.

Calibration of the level gauge associates the detector readings, known as counts, with the level of the material in engineering units

## System overview

The LFXG-D flexible detector uses VEGA's GEN2000® electronics. The GEN2000 is VEGA's newest compact electronics that support 4 ... 20 mA HART®, FOUNDATION Fieldbus protocol, or frequency output. The level measurement system consists of three main components:

1. Source holder
2. FiberFlex® flexible detector assembly LFXG-D
3. Communication device (Fieldbus host)

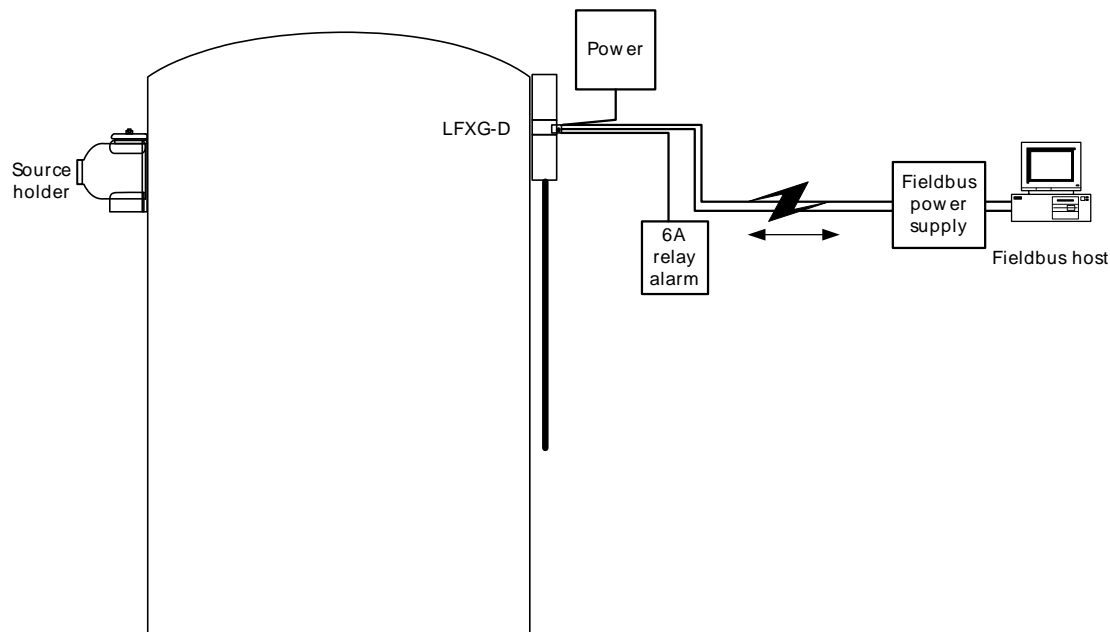
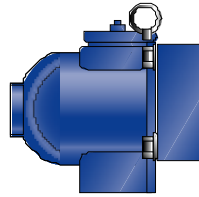


Figure 2: System overview

The following statements describe the source holder:

- A cast or welded steel device that houses a radiation-emitting source capsule
- Directs the radiation in a narrow collimated beam through the process vessel
- Shields the radiation elsewhere
- The model chosen for each particular system depends on the source capsule inside and the radiation specification requirements
- A shutter on the source holder either completely shields the radiation (source off) or allows it to pass through the process (source on)

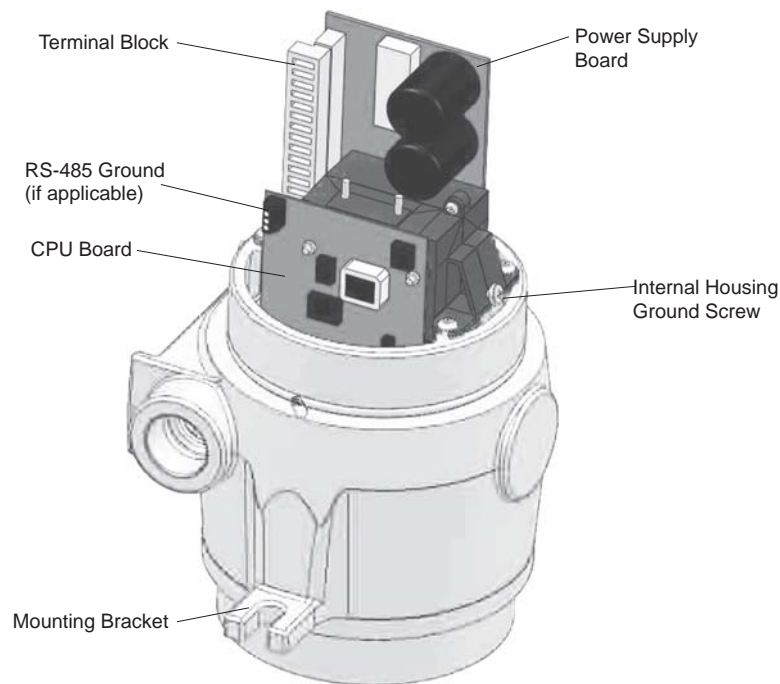


*Figure 3: Typical source holder*

# Scintillator model LFXG-D

The following statements describe the functions of the FiberFlex flexible detector assembly (model LFXG-D):

- Mounts opposite the source holder
- Inside the flexible detector is a scintillation material
- The scintillation material produces light in proportion to the intensity of its exposure to radiation
- A photomultiplier tube detects the scintillator's light and converts it into voltage pulses
- The microprocessor receives these voltage pulses after amplification and conditioning by the photomultiplier tube
- The microprocessor and associated electronics convert the pulses into a calibratable output



*Figure 4: LFXG-D exploded view*



# What is Fieldbus?

Fieldbus is a digital bus that is similar to a computer network. Fieldbus enables two-way data communication between the gauge and the fieldbus PC. The fieldbus gauge has the following features:

- Implements control functions (algorithms) in the actual device instead of a central computer
- Ensures device interoperability because of device registration with the Fieldbus Foundation®
- Uses device specific device description (DD) for configuration
- Sends data directly between devices which speeds up control functions

This manual assumes a working knowledge of fieldbus terminology and practices. The procedures in this manual are appropriate for FOUNDATION Fieldbus.

## Links

A FOUNDATION fieldbus network consists of devices connected by a serial bus, also known as, a link. Special devices known as bridges can separate the links.

## Devices

The fieldbus network can have a maximum of 32 devices depending on power requirements.

There are three types of devices on a field bus network:

- Link master
- Basic devices
- Bridges

# Link master

The link master device controls communications traffic on a link. It prevents multiple devices from communicating data at the same time. It can be a distributed control system (DCS) or any other device, such as, a valve or pressure transducer. There can be more than one link master per link, but only one link master can be the Link Active Scheduler (LAS) at any given time.

## Basic device

A basic device cannot become the LAS. The LFXG-D is a basic device.

## Bridge

A bridge connects two or more links.

## Device identification

You can identify devices by character string names or tags. The device tag is configurable attribute of the device that usually describes the type of device. Device tags are unique to each device on a fieldbus network.

Another unique identifier is the device ID. This ID includes a serial number that is unique to the device. This identifier is assigned by the device manufacturer and cannot be changed.

# Blocks and parameters

The level gauge has a set of functions that it can perform. These functions are designated as function blocks within the device. The function blocks supported by the LFXG-D are:

- One resource block
- Three transducer blocks (TB)
- Two analog inputs (AI)
- One analog output (AO)

The classification of functions block parameters are:

- Input parameters that receive data from another block
- Output parameters that send data to another block
- Contained parameters that do not receive or send data but are kept within the block

Function blocks can also classify as alarms, trends, or tuning parameters. These classifications are independent of input, output, and contained classifications. For example, an input parameter can also be an alarm, trend, or tuning parameter.

## Device description files

VEGA supplies device description (DD) files for the LFXG-D. The DD files configure the level gauge. Examples of information in the DD files are:

- Names
- Help strings
- Menus and methods

## Identifying blocks

Blocks have unique identifiers similar to the device tag. The block tag describes the purpose and location of the block. You can change block tags but each block must have a unique identifier.

## Linkages

A linkage is a logical connection that connects two function blocks. The linkage enables data to send from one function block to another. For example, a linkage enables the output parameter (parameter that writes to the bus) to the input parameter (block that receives the data). The linkage can connect blocks in the same or different devices.



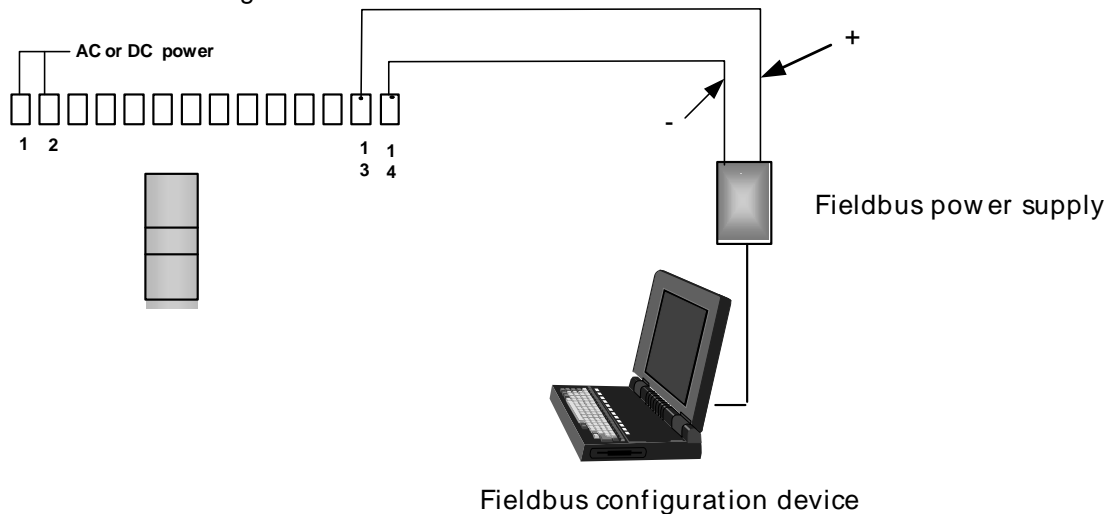
# Chapter 2: Installation

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## Testing on the bench

To ensure a quick start up after installation, you can test the detector assembly with the fieldbus configuration device (a personal computer). Bench testing enables you to check the following:

- Power
- Communication
- Initial setup software parameters
- Some diagnostics



*Figure 5: Bench test setup*

## Location considerations

When you ordered the gauge, VEGA sized the source for optimal performance. Notify VEGA before installing the gauge if its location differs. Satisfactory operation depends on proper location.



**Note:** Locate the source holder where process material cannot coat it. This ensures the continuing proper operation of the source ON/OFF mechanism (if applicable). Many regulatory bodies (for example, the U.S. NRC) require periodic testing of the ON/OFF mechanism.

See the ***Radiation Safety for U.S. General and Specific Licensees, Canadian and International Users*** manual and the ***Radiation Safety Manual Addendum of Reference Information*** CD that came with the source holder and the appropriate current regulations for details.

## Stable temperature

Mount the gauge on a portion of the line where the temperature of the process material is relatively stable. Process temperature can affect the gauge indication. The amount of the effect depends on:

- Sensitivity of the gauge
- Temperature coefficient of the process material

## Protect insulation

Protect from liquid any insulation between the measuring assembly and the process. The absorption of a liquid, such as water, can affect the gauge indication because it blocks some radiation.

## Avoid internal obstructions

The best possible installation of a nuclear level gauge is on a vessel that has no internal obstructions (example: agitator, baffle, man ways) directly in the path of the radiation beam. If one of these obstructions is present, it can shield the radiation from the detector, causing an erroneous reading.

If the vessel has a central agitator, the source holder and detector can mount to the vessel on an arc other than a diameter, so the beam of radiation does not cross the agitator. You can avoid other obstructions this way.

## Avoid external obstructions

Any material in the path of the radiation can affect the measurement. Some materials that are present at the time of calibration pose no problem because the calibration accounts for their effect.

Examples:

- Tank walls
- Liners
- Insulation

However, when the materials change or you introduce new ones, the gauge reading can be erroneous.

Examples:

- Insulation that you add after calibration absorbs the radiation and causes the gauge to erroneously read upscale.
- Rapidly changing tank conditions due to material buildup. Regular standardizations compensate for slowly changing tank conditions due to material buildup. See the Calibration chapter for information on standardization.

## Avoid source cross-talk

When multiple adjacent pipes or vessels have nuclear gauges, you must consider the orientation of the source beams so each gauge senses radiation only from its appropriate source.

The best orientation, in this case, is for the source holders to be on the inside with radiation beams pointing away from each other.

# Mounting the measuring assembly

## Mounting Options

### Bracket Mount

The L bracket supports the electronics housing. For this type of mounting, the conduit clamps should be spaced every 18" (45cm).

### Conduit Mount

This type of mount consists of an adapter with a 2" conduit coupler (part number 240721). It provides an air hose fitting for applications that must cool the gauge. The pole mount requires a nipple and union.

**Note:** The detector active area (where it is possible to make a level measurement) is between 1" (25 mm) from the bottom of the GEN2000 housing to the end of the flexible conduit. Mount the detector so that this area spans the measurement length.



**Note:** In some cases, the handle on the source holder operates a rotating shutter. When installing or removing the assembly from the pipe, you must turn the handle to the closed (OFF) position and lock the handle with the combination lock provided.

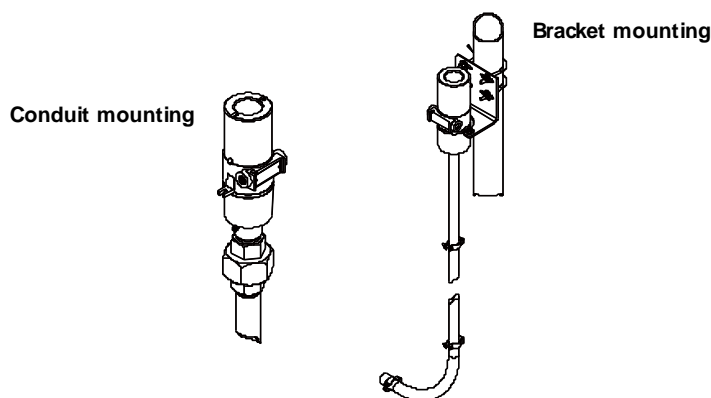


Figure 6: Conduit and bracket mounting



## Wiring the equipment

**Note:** If you have received an interconnect drawing from VEGA or the engineering contractor and the instructions differ from the instructions in this manual, use the drawing. It may contain special instructions specific to your order.

Use the drawing notes and the steps that follow to make the input and output connections. Make the connections at the removable terminal strips mounted on the power board. To access the power board, remove the explosion-proof housing cap.

VEGA provides an internal and external ground screw to connect the power Earth ground wire. Remove the top cover; the internal ground screw is located at the front of the housing. The external ground screw is located next to the conduit entry.

**Note:** Not all connections are required for operation.

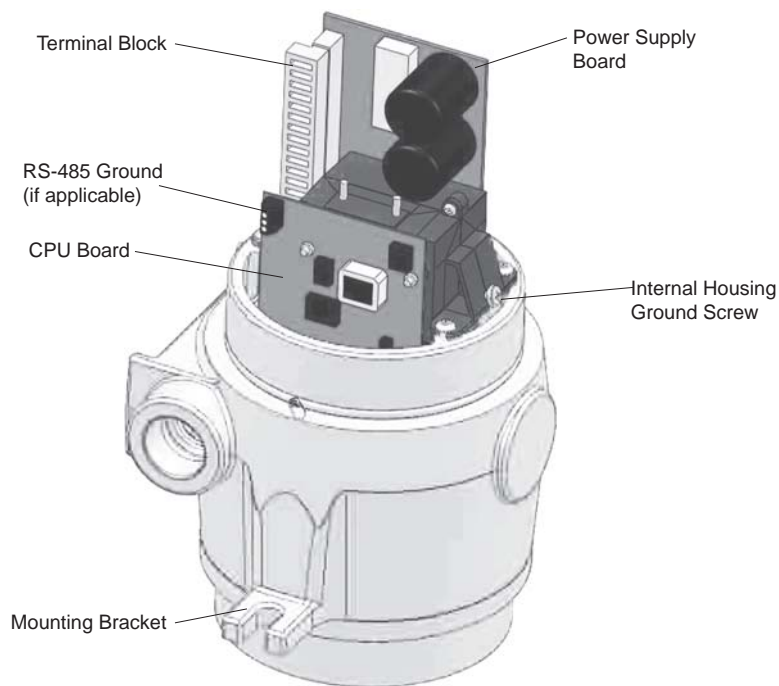
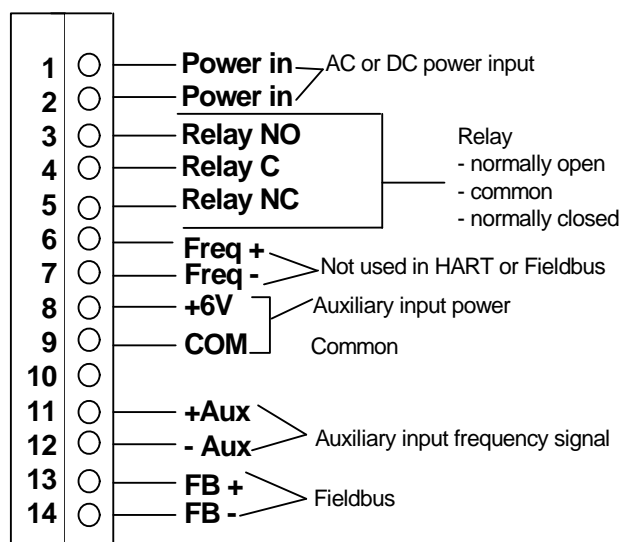


Figure 7: LFXG-D internal and external ground screw



Interconnecting terminals - GEN2000 with Foundation Fieldbus

Figure 8: Interconnect

Table 5: Terminal names and descriptions

Terminal	Name	Description
1	L1	AC or DC power input
2	L2	AC or DC power input
3	RY NO	Relay normally open
4	RY C	Relay common
5	RY NC	Relay normally closed
6	Freq+	Not used in FB applications
7	Freq-	Not used in FB applications
8	+6V	Auxiliary input power
9	COM	Auxiliary input power common
10	N/A	Not used
11	Aux+	Auxiliary input frequency signal
12	Aux-	Auxiliary input frequency signal
13	FB+	Fieldbus positive terminal
14	FB-	Fieldbus negative terminal

**Note:** The power input terminals are not polarity sensitive.

## Power



### CAUTION!

DO NOT APPLY POWER until a thorough check of all the wiring is complete!

### Special installation, maintenance, or operating instructions

If it is necessary to open the sensor, the following warning applies:

**EXPLOSION HAZARD** - Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

**AVERTISSEMENT: - RISQUE D'EXPLOSION** - AVANT DE DÉCONNECTER L'ÉQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

### CAUTION!

Open circuits before removing cover. An explosion-proof seal shall be installed within 450 mm (18") of the enclosure.

**AVERTISSEMENT:** - Ouvrir les circuits avant d'enlever le couvercle. Un scellement doit être installé à moins de 450 mm du boîtier.

### CAUTION!

Allow a minimum of 10 minutes before opening the GEN2000® for internal inspection. This allows time for the gauge to de-energize, cool, and fully discharge the capacitor.

AC power requirements for the LFXG-D are:

- 4-wire hookup (15W of AC)
- AC power source voltage input is 90–254VAC at 50/60 Hz, at 15W (without heater) or 25W (with optional heater) maximum power consumption
- AC power must not be shared with transient producing loads
- Use an individual AC lighting circuit.
- Supply an extra earth ground

DC power requirements for the LFXG-D are:

- DC power source voltage input is 20–60VDC (24VDC $\pm$ 10% for CE compliance) less than 100mV, 1/1.000 Hz ripple at 10VA maximum power consumption
- Power is polarity independent
- Supply an extra earth ground
- DC power allows the use of a single cable
- Use a 4-wire hookup with two wires for power and two for fieldbus communication

The fieldbus gauge uses 0.3W of power from the fieldbus power supply. All wiring must have insulation suitable for at least 250V.

### Switch for CE compliance

For CE compliance, install a power line switch no more than one meter from the operator control station.

### Fieldbus signal cable

Fieldbus signal that is available on terminal P1-13 is positive and P1-14 is negative.

The preferred fieldbus cable for conformance testing has the following specifications:

- Shielded, twisted pair
- #18AWG (.8mm<sup>2</sup>)
- Maximum total length including spurs 1,900m (6,232ft)
- Maximum spur length 120m (394ft)

An alternate preferred field bus cable has the following specifications:

- Multiple twisted pair with an overall shield
- Size—#22AWG (.32mm<sup>2</sup>)
- Maximum total length including spurs—1,200m (3,936ft)
- Maximum spur length 100m (328ft)

Use of this cable will be in both new and retrofit installations where multiple fieldbus systems are run in the same area of the plant.

If using DC power, signal and power can run on a single cable 4-wire hookup (two wires for power, two for fieldbus interconnect).

All wiring must have insulation suitable for at least 250V.

**Caution!** Use supply wires suitable for 40 °C (104 °F) above surrounding ambient temperature.

### Communication

To install and configure the hardware and software for your fieldbus system, refer to the manuals that came with your fieldbus hardware and software. The installation and configuration may vary depending on the operating system.

## Conduit

Conduit runs must be continuous and you must provide protection to prevent conduit moisture condensation from dripping into any of the housings or junction boxes. Use sealant in the conduit, or arrange the runs so that they are below the entries to the housings and use weep holes where permitted.

You must use a conduit seal-off in the proximity of the housing when the location is in a hazardous area. Requirements for the actual distance must be in accordance with local code.

If you use only one conduit hub, plug the other conduit hub to prevent the entry of dirt and moisture.

## Commissioning the gauge

The process of commissioning the gauge includes the following:

- Taking appropriate radiation field tests
- Checking the pre-programmed setup parameters
- Calibrating on process
- Verifying the working of the gauge.

VEGA Field Service Engineers typically commission the gauge. It is necessary to remove the source holder lock the first time the gauge takes measurements in the field. Only persons with a specific license from the U.S. NRC, Agreement State, or other appropriate nuclear regulatory body may remove the source holder lock.



**Note:** Users outside the U.S. must comply with the appropriate nuclear regulatory body regulations in matters pertaining to licensing and handling the equipment.

## Can you remove the source holder lock?

If you are in doubt whether you have permission to remove the source holder lock...Do not!

The license sets limits on what the user can do with the gauge. Licenses fall into two categories:

1. General
2. Specific

It is up to the user to review the license to determine if they have the appropriate permission to perform any of the following:

- Disassemble

- Install
- Relocate
- Repair
- Test
- Unlock

You can remove the source lock if installation of the gauge is in the U.S. and you have the specific license to remove the source holder lock. Confirm that your license specifically states that you have the permission to perform this operation and then contact VEGA Field Service Radiation Safety for the combination.

Do not remove the lock if the gauge has a general license tag, installation is in the U.S., and you do not have the specific license that gives you permission to remove the lock. You can verify whether the gauge is a general license gauge by checking the source holder for the general license tag. If it is not there, it is not a general license device.

If you do not have permission to remove the source holder lock, an VEGA Field Service Engineer or another person with this specific license must remove it for you.

## Field service commissioning call checklist

In many U.S. installations, an VEGA Field Service Engineer commissions the gauge. To reduce service time and costs, use this checklist to ensure the gauge is ready for commission before the Field Service Engineer arrives:

- ☑ Mount the source holder and detector per the certified drawings provided by VEGA. Allow access for future maintenance.
- ☑ Make all wiring connections per the certified drawings and the “Wiring the Equipment” section in this manual. Tie in the wiring from the field transmitter to the DCS/PLC/fieldbus recorder.
- ☑ Ensure that the AC power to the transmitter is a regulated transient-free power source. UPS type power is the best.
- ☑ If using DC power, verify that the ripple is less than 100mV.

**Note:** The equipment warranty is void if there is damage to the gauge due to incorrect wiring not checked by the VEGA Field Service Engineer.

- ☑ Have process ready for calibration.
- ☑ When possible, it is best to be able to completely fill and empty the vessel, at the high and low levels for the calibration procedure, and when possible at 10% increments in between for the linearization procedure.
- ☑ Do not remove the lock on the source holder. Notify VEGA Field Service if there is damage to the lock or it is missing.

Notes



# Chapter 3: Fieldbus configuration

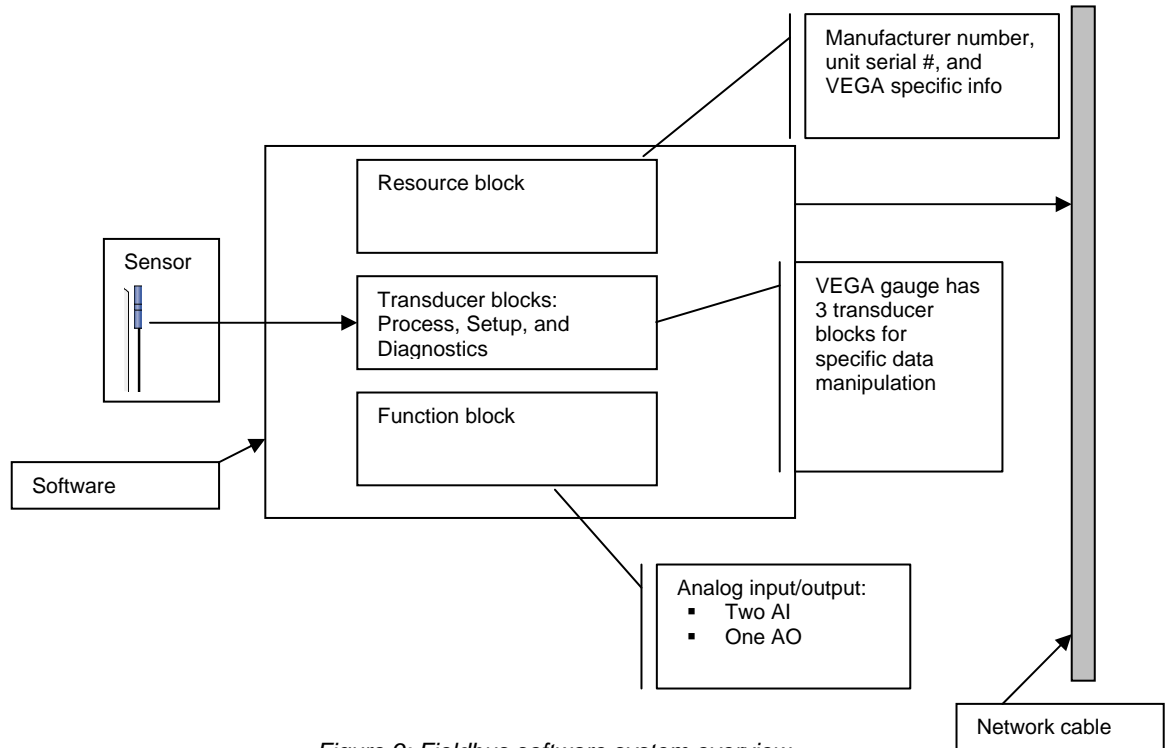


Figure 9: Fieldbus software system overview

In order to use the level gauge you must install VEGA's Foundation fieldbus level DD on the fieldbus host system.

Instructions for configuration of the software and interfaces are included in the fieldbus manuals that come with your fieldbus hardware and software.

Typical configuration for fieldbus system includes the following:

- Connect the devices in a segment
- Import the device descriptions (DD) to the host
- Set addresses and tags
- Formulate a control strategy
- Schedule function blocks and communication
- Configure alarms
- Set static parameters
- Configure input/output
- Set network parameters

Use your specific host software manuals to perform the configurations.

### Step 1: Connecting the devices

You must wire the LFXG-D to the fieldbus network.

### Step 2: Import the device descriptions

Refer to your specific host software manual for information on how to download the VEGA device descriptions.

### Step 3: Set address and tags

Each device has a physical device tag and a fieldbus network address. You must assign a unique tag to each device. Each address must be unique within a fieldbus segment.

Each device has function blocks that perform control functions, such as:

- AI
- AO

Devices also have transducer blocks that perform I/O with sensors and actuators. You must assign a unique tag to function and transducer blocks.

Setting a device or block tag can affect how other host machines on an online operating network access the device.

#### **Caution!**

Take care when you set the tags. Verify that the operating control system is not using the device or function block. When you set the device tag, the device loses all linkage and communication configuration information and control of the process.

### Step 4: Formulate a control strategy

You must configure the following to define your control strategy.

- Identify the function blocks
- Connect the relevant function blocks
- Configure loop or cycle times

Refer to your specific host software manual for information on how to define your control strategy.

## Step 5: Schedule function blocks and communication

Fieldbus schedules the execution of function blocks and the communication between the connected function blocks. The two schedules synchronize to prevent over sampling.

Function blocks contain an algorithm and several parameters to control a process. Refer to your specific host software manual for information on how to schedule your function blocks.

## Step 6: Configure alarms

To configure alarms, identify the function blocks that generate alarms and the hosts that receive the alarms. You must also configure the alarm limits and priorities.

You can configure a device, such as a PC, to receive alarms that the function blocks generate. Refer to your specific host software manual for information on how to configure the alarms.

### Step 7: Set static parameters

For your control strategy to work, you must configure static parameters, such as scaling parameters like XD\_SCALE in AI/AO blocks. Refer to your specific host software manual for information on how to set the static parameters.

To setup the Transducer blocks and AI block parameters, refer to Chapter 4: LFXG-D setup on page 31.

### Step 8: Configure input/output

Sensor and actuator I/O typically models as a transducer block. Refer to your specific host software manual for information on how to configure the input and output blocks.

### Step 9: Set network parameters

You must configure the fieldbus communication-specific network parameters for communication and scheduling to function properly. Refer to your specific host software manual for information on how to configure the network parameters.

# Chapter 4: LFXG-D setup

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This chapter includes the specific procedures necessary to setup the VEGA nuclear level gauge.

Using VEGA's Foundation Fieldbus Device Description (DD), you can view or edit the variables in VEGA's Foundation Fieldbus gauge transducer block in two of the following ways:

- Use the transducer blocks variable list directly
- Use menus provided by VEGA's DD

The menu structure in VEGA's DD provides an easier access to the most commonly used variables and methods. Under the menus, the variables are separated by functions, such as:

- Setup parameters
- Information parameters
- Calibration parameters

**Note:** Not all host systems support this menus capability. If your host does support menus capabilities, the host software documentation will describe how to access these menus.

The procedures in this manual describe both methods of viewing and editing transducer block variables.

Refer to Appendix IV for illustrations of the transducer blocks (TB) menus associated with the Fieldbus software.

The transducer blocks enable access to all of the parameters. For ease of use, VEGA has divided the parameters and user methods by function into the three transducer blocks:

1. Process (usually labeled TRANSDUCER 449)
2. Setup (usually labeled TRANSDUCER 508)
3. Diagnostics (usually labeled TRANSDUCER 569)

There are four main setup requirements. They are:

1. Process (Primary Value Range, Calibration Parameters, and Filtering)
2. System (Source Type and Source Functions)
3. Alarm (X-ray Threshold)
4. Auxiliary (Secondary Filter Value, Compensation Select, and Compensation Source)

The following TRANSDUCER BLOCK and AI\_BLOCK parameters are the only variables that must be set up for a basic level measurement.

**PROCESS TRANSDUCER BLOCK (449)**

- DEVICE SELECT (set to Level)
- PRIMARY VALUE\_RANGE

**SETUP TRANSDUCER BLOCK (508)**

- FILTER TYPE
- FAST CUTOFF (default is 0)
- DATA COLLECT INTERVAL
- LINEARIZER TYPE

**DIAGNOSTICS TRANSDUCER BLOCK (569)**

- LINEARIZER VALUE (optional—only if using the table-nonlinear type)
- LINEARIZER COUNTS (optional—only if using the table-linear type)

**AI BLOCK**

- XD\_SCALE
- OUT\_SCALE
- CHANNEL (set to Primary Channel)

## Process setup

Process configuration requires the set up of the following parameters:

- Primary value range
- Calibration parameters
- Filtering

You can setup the process configuration directly in the various transducer block parameters. If you have a menus interface, you can access some of these parameters from the transducer blocks submenus.



## Primary value range

Process value range is the lowest and highest level (EU\_0 and EU\_100 level) measurement with the gauge. The level transmitter calibrates within these settings. These define the endpoints for the calibration and linearizer curve.

**Note:** The minimum and maximum level values for the process value range are essential to proper calibration of the system. You must enter the minimum and maximum level for process value range before you perform a calibration. You must perform a new calibration procedure if there is a change in the process range minimum or maximum levels values.

Modify the process value range setting if the level transmitter moves from its intended location, or is measuring on a different range. It is a good practice to verify that the setting is correct before performing a calibration.

The primary value is set in the **PRIMARY\_VALUE\_RANGE** sub-parameters.

You must set up the following sub-parameters for the primary value:

- EU at 100%—The value that represents the upper end of range (maximum level) of the process level (sub-parameter EU\_100). For example, 100% can equal the highest level of 100 feet.
- EU at 0%— The value that represents the upper end of range (maximum level) of the process level (sub-parameter EU\_0). For example, 0% can equal the lowest level of 1 foot.
- Units Index—The DD units code index for the engineering unit descriptor for the associated block value (sub-parameter UNITS\_INDEX).
- Decimal—The number of digits to the right of the decimal point that should be used by an interface device in displaying the specified parameter (sub-parameter DECIMAL).

## Setting process value

*Procedure 1: To set the process value*

1. From **Process TB 449**, click **PRIMARY\_VALUE\_RANGE** parameter
2. From the **PRIMARY\_VALUE\_RANGE** parameter, click **EU\_100** sub-parameter
3. Type the EU\_100 value
4. From the **PRIMARY\_VALUE\_RANGE** parameter, click **EU\_0** sub-parameter
5. Type the EU\_0 value
6. From the **PRIMARY\_VALUE\_RANGE** parameter, click **UNITS\_INDEX** sub-parameter
7. Scroll and click on one of the following unit types:
  - Counts per Second
  - Unitless
  - in
  - ft
  - cm
  - mm
  - m
  - %
8. From the **PRIMARY\_VALUE\_RANGE** parameter, click **DECIMAL** sub-parameter
9. Type the number of places to the right of the decimal that you want to display.

**Note:** The process transducer block 449's **PRIMARY\_VALUE\_RANGE** units (**UNITS\_INDEX**) sub-parameter must match the units (**UNITS\_INDEX**) in the Analog Input (AI) block, sub-parameter (**XD\_SCALE** and **PV\_SCALE**). An error message displays if this is not set correctly and the AI block will not switch to AUTO mode.

## Calibration parameters

Calibration parameters include the following:

- Data collect interval
- Warning delta
- Process standardization config
- Standardize interval

### Data collect interval

Data collection interval is the time in seconds over which the system collects a process measurement. Use this interval time to collect data for the following:

- Calibration
- Linearizer data points
- Standardization
- Diagnostic

### Warning delta

Warning percentage span calibration is the difference between the two calibration points (cal low and high level values) as a percent of level span that causes a warning to appear. For a good calibration, it is important for the two calibration points to be as far apart as possible. The default value is 10%. The user typically does not need to change this value for most applications.

## Process standardization configuration

Standardization adjusts the system by resetting one point of the calibration curve to an independently measured or known level.

The frequency of standardization depends on several factors, including desired accuracy of the reading.

Set up the following sub-parameters for standardization:

- STANDARDIZE\_POINT
- STANDARDIZE\_TYPE

### Standardize point

Process value recorded for the last standardization.

### Standardize type

Process standardize type determines how you enter the actual process value of a standardize sample. If this is set as Use Lab sample value, the software screens prompts entry of the sample value during a standardize. If this is set as Use Default value, the software always uses the Default standardize level as the sample value.

### Standardize default value

Default standardize is the default level value in engineering units that you use in the standardization procedure. At standardization, enter the actual level of the process material to override this default.

### Standardize interval

Standardize interval is the interval in days between standardize alarms. The level transmitter alarms to indicate that a standardize procedure is due if the diagnostic alarm, Standardize due, is set.

## Setting the calibration parameters

*Procedure 2: To set the calibration parameters*

1. Set up the Data Collect parameter
  - 1.a. From **Setup TB 508**, click **DATA\_COLLECT\_INTERVAL**
  - 1.b. Type the time in seconds that the system will use to average the sensor counts
2. Set up the Warning Delta parameter
  - 2.a. From **Setup TB 508**, click **WARNING\_DELTA**
  - 2.b. Type the difference between the two calibration points (cal low and high level values) as a percent of level span that causes a warning to appear. The default value is 10%.
3. Set up the Process Standardization Configuration
  - 3.a. From **Setup TB 508**, click **STANDARDIZE\_TYPE**
  - 3.b. Select one of the following:
    - **Use Lab sample value**
    - **Use Default value**
4. Set up the Standardize Point parameter
  - 4.a. From **Setup TB 508**, click **STANDARDIZE\_POINT**
  - 4.b. Type the process value recorded for the last standardization
5. Set up the Standardize interval parameter
  - 5.a. From **Setup TB 508**, click **STANDARDIZE\_INTERVAL**
  - 5.b. Type the number of days desired between each standardize.

## Filtering

This feature enables change to the response time of the system by increasing or decreasing the averaging time that is used to filter the noise in the signal. An increased time for averaging enables the accumulation of a greater number of readings and therefore produces a greater statistical accuracy. However, this is at the expense of response time to changes in the process.

Filtering parameters include:

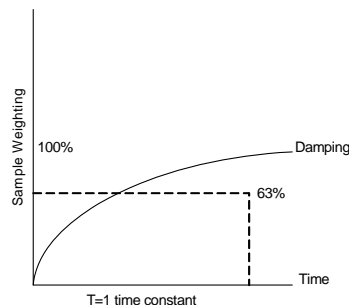
- Filter type
- Primary filter value
- Fast cutoff

### Filter type (RC exponential or digital)

The level transmitter offers a choice of signal filters, RC exponential or rectangular window (digital). The level transmitter has a sample rate of about 1sample/second, but process variables generally change measurably on the order of minutes. Electrical and source noise occur on the order of seconds, so they can be filtered out with a low pass filter, leaving only the change in the process variable in the signal.

### RC exponential

RC exponential filtering simulates the traditional Resistance/Capacitance filtering. It provides an infinite impulse, in which all of the previous samples contribute less and less to the average, but all contribute somewhat. The most recent samples are weighted most heavily in computing the average. Compared to digital filtering, RC exponential filtering provides a quicker response to step changes in the process but has a larger noise band.



*Figure 10: RC exponential filtering*

## Digital filtering

Digital filtering computes an average based only on a specified (finite) number of samples. All samples are weighted equally in the average. Although it provides a slower step response (since the most recent measurements are weighted the same as those further back in time), it produces a less noisy signal. Generally, digital averaging by itself produces results similar to combining RC exponential filtering with the fast cutoff feature.

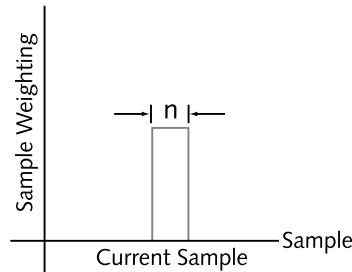


Figure 11: Digital filtering

## Primary filter value

The primary filter value is the filter time constant applied to the final PV output. The type of filter you choose determines the primary filter value.

With the RC exponential method, the primary filter value entry is equivalent to a time constant, that is, the amount of time (in seconds) that it takes for the gauge reading to achieve 63.2% of a step change in process. A range of integer values from 1–600 seconds is possible for this time constant entry.

With the digital filtering, the primary filter value entry determines how many samples to use when calculating the average, responding to 100% of a process step change. The maximum damping entry is 100 with this type of filtering.

## Fast cutoff

Fast cutoff temporarily bypasses the RC or digital filtering when the change in process exceeds this value (in engineering units) between successive samples. This enables the level transmitter to respond immediately to large step changes while filtering the smaller variations in the signal caused by noise and normal process variations. To turn off the fast cutoff filter, set the value to zero.

## Setting the filter type, primary filter value, and fast cutoff parameters

*Procedure 3: To set the filter type, primary filter value, and fast cutoff*

1. Set up the filter type parameter
  - 1.a. From **Setup TB 508**, click **FILTER\_TYPE**
  - 1.b. Select either:
    - **rc filter**
    - **digital filter**
2. Set up the primary filter value parameter
  - 2.a. From **Setup TB 508**, click **PRIMARY\_FILTER\_VALUE**
  - 2.b. Type the filter time constant to apply to the final PV output
3. Set up the fast cutoff parameter
  - 3.a. From **Setup TB 508**, click **FAST\_CUTOFF**
  - 3.b. Type the correct value for a fast cutoff response or zero to turn the fast cutoff feature off.



## System setup

The system parameters define settings for the internal operation of the level transmitter and the radiation source.

Source functions can be set in the transducer block parameters..

## System parameters

System configuration requires the setup of the following:

- Source type
- Source functions

### Source type

Use the source type feature to view or enter the isotope in the source holder that produces the radiation signal. The VEGA factory enters this parameter based on information received at the time of the order. You can check the isotope type against the source holder label.

*Procedure 4: To set the source type parameter*

1. From **Setup TB 508**, click **SOURCE\_TYPE**
2. Scroll and select one of the following radiation sources:
  - **Cs137**
  - **Co60**
  - **AM241**
  - **CF252**
  - **No source**

### Source functions

Source functions can be set in the transducer block parameters.

Complete the system configuration by setting up the following:

- Wipe interval
- Shutter check interval

#### Wipe interval

Use the wipe interval feature to view or enter the interval in days between successive source wipe diagnostic alarms. Check with current applicable regulations.

#### Record wipe now

Use the record wipe feature to reset the diagnostic alarm “source wipe due.” For more information, see the “Diagnostics and Repair” chapter.

#### Shutter check interval

Use the shutter check interval feature to enter the number of days between successive shutter check diagnostic alarms. Check with current applicable regulations for recommendations on shutter check intervals.

#### Record shutter check now

Use the Record shutter check now feature to reset the diagnostic alarm “shutter check due.” For more information, see the “Diagnostics and Repair” chapter.

## Days till wipe

Use the days till wipe feature to view the number of days until the next source wipe alarm. For more information, see the “Diagnostics and Repair” chapter.

## Days till shutter check

Use the days until shutter check feature to view the number of days until the shutter check alarm. For more information, see the “Diagnostics and Repair” chapter.

*Procedure 5: To set the source function parameters*

1. Set up wipe interval
  - 1.a. From **Setup TB 508**, click **WIPE\_INTERVAL**
  - 1.b. Type the interval (in days) between successive Source Wipe Due messages. Set according to license, source, and applicable regulations
2. Set up shutter check interval
  - 2.a. From **Setup TB 508**, click **SHUTTER\_CHECK\_INTERVAL**
  - 2.b. Type the interval (in days) between successive Shutter Check Due messages. Set the interval according to license, source holder model, and applicable regulations.

## Alarm setup

Alarm configuration enables the setup of the x-ray threshold. The x-ray alarm feature can be set in the transducer block parameters

### X-ray alarm setup

The x-ray alarm compensates for false indicated process values that occur when the gauge detects external radiographic sources. Vessel weld inspections often use portable radiographic sources. Detection of x-rays by the gauge causes a false low reading and adversely affects any control based on the gauge output.

When the gauge detects a radiation field above a set threshold (as a percentage of the calibration low counts value), it sets the PV output at its value 10 seconds before the detection of the x-ray interference until the radiation field is back to the normal level or until a time-out period of 60 minutes.

**Note:** Only VEGA Field Service can adjust the time-out period of 60 minutes and the reversion to 10 seconds before the x-ray detection.

### Threshold

Threshold is the percentage beyond the calibration low counts that triggers x-ray interference suppression. Default value 1%.

### Setting up the x-ray alarm parameters

*Procedure 6: To set the x-ray alarm parameters*

1. From **Setup TB 508** parameters, click **XRAY\_THRESHOLD**
2. Type the percentage value beyond the calibration low counts that triggers x-ray interference suppression.

## Auxiliary input setup

Auxiliary input or compensation configuration requires the setup of the following:

- Secondary filter value
- Compensation selection
- Compensation source

The auxiliary input is an option for the fieldbus level transmitter to receive a frequency signal. With special software, the frequency signal incorporates into the final output. Auxiliary input is configured in the **Process TB 449** parameters.

### Secondary filter value

Secondary filter value is the auxiliary input signal with application of the time constant. The filter type (RC or digital) applied to the auxiliary input is the same as the primary channel.

### Compensation type selection

The software provides special settings for three typical uses of a frequency input:

- Summation mode
- NORM compensation
- Vapor pressure compensation

## Compensation source

This parameter defines the source of the compensation input frequency.

There are two types of compensation sources:

- Compensation input frequency supplied by a frequency gauge wired to the auxiliary input (AI) of the Foundation Field gauge (pins 11 and 12 of the power supply terminal block)
- Compensation input frequency supplied from the auxiliary output (AO) block of the gauge

## Setting the auxiliary input filter and compensation type

*Procedure 7: To set the auxiliary input filter and compensation type*

1. From **Setup TB 508**, click **SECONDARY\_FILTER\_VALUE**
2. Type the value
3. From **Setup TB 508**, click **COMPENSATION\_SELECT**
4. Select one of the following:
  - **Undefined**
  - **None**
  - **NORM Compensated Lvl**
  - **Vapor Compensated Lvl**
  - **Summation**

## Setting the compensation source

There are two choices for compensation sources with Auxiliary Input:

1. Internal
2. External

**Note:** You must also set up the AO\_BLOCK if the compensation frequency input is coming from an external source. The following AO block parameters must be setup as follows:

- **CHANNEL**=Compensation value
- **PV\_SCALE|UNITS\_INDEX**=Counts per second
- **XD\_SCALE|UNITS\_INDEX**=Counts per second
- **MODE\_BLOCK**=Cascade

*Procedure 8: To set the compensation source and AO\_BLOCK parameters*

1. From **Process TB 449**, select **COMPENSATION\_SOURCE**
2. Click on the Value field and select either of the following:
  - **Undefined**
  - **None**
  - **Internal**
  - **External**
3. If it is an external source, perform steps 3.a. through 3.e.
  - 3.a. Select the **AO\_BLOCK**
  - 3.b. From the **AO\_BLOCK** parameters, click **CHANNEL** and select **Compensation value** from the list
  - 3.c. Click **PV\_SCALE** and the sub-parameter **UNITS\_INDEX** and select **counts per second**
  - 3.d. Click **XD\_SCALE** and the sub-parameter **UNITS\_INDEX** and select **counts per second**
  - 3.e. Click **MODE\_BLOCK** parameter and select **Cascade**.

Note



# Chapter 5: Calibration

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Calibration establishes a reference point or points that relate the detector output to actual (or known) values of the process.

You must perform a calibration before the gauge can make accurate measurements. Perform the calibration after the installation and commission of the gauge at the field site.

You do not need to repeat the calibration procedures if certain critical process and equipment conditions remain unchanged. The gauge requires only a periodic standardization to compensate for changing conditions.

## Choosing the calibration method

For each installation, you must choose a method to calibrate the gauge. In almost all cases, the standard method is the best.

Calibration methods

Standard method	Simple method
Use if the gauge is required to be repeatable and precisely or linearly indicate the level of process throughout the span.	Use if the gauge is only required to be repeatable, but need not precisely indicate the level of process.
Use for vessels in which it is critical to know the precise level.	Typically used for surge bins or other vessels that are under control and that maintain one level.
The linearizer type chosen must be Non-linear table.	The linearizer type chosen must be Linear table.

**Note:** The simple method produces a measurement indication that is repeatable but not precise between the Cal Low Level and Cal High Level points. The measurement indication is not linear with respect to the actual process level.

In some applications, precision is not critical and this method is valid.

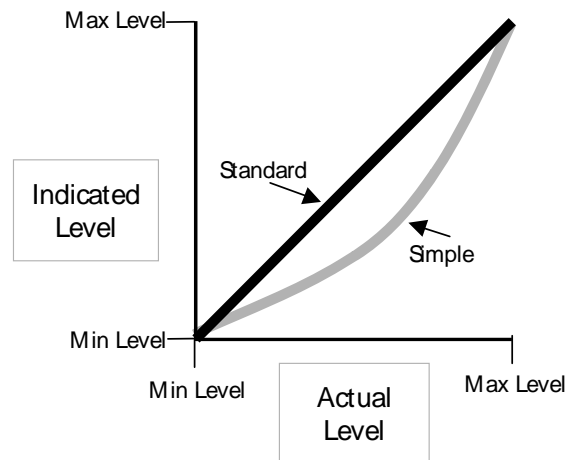
## Theory of calibration

### Both calibration methods

Enter the values that define the maximum and minimum levels to measure. These parameters are Max Level and Min Level, and must be set correctly before any of the calibration steps.

Collection of data points nearest the Maximum (but not higher) and Minimum (but not lower) levels occurs during calibration. Refer to the “Two Point Cal” procedure in this manual for the steps necessary to collect these data points. In Figure 13, stars indicate the Maximum and minimum level data points.

Figure 12 illustrates the effect on the final output of using the non-linear table vs. the linear table for the linearizer. Using the non-linear table linearizer in the standard method produces a linear output. Using the linear table linearizer table produces a non-linear output.



*Figure 12: Indicated level vs. actual level*

## Standard calibration method

A standard calibration method requires collection of intermediate data points. Use the **Linear data collect** function from the TB parameters to collect these data points. In Figure 13 , circles indicate the intermediate data points.

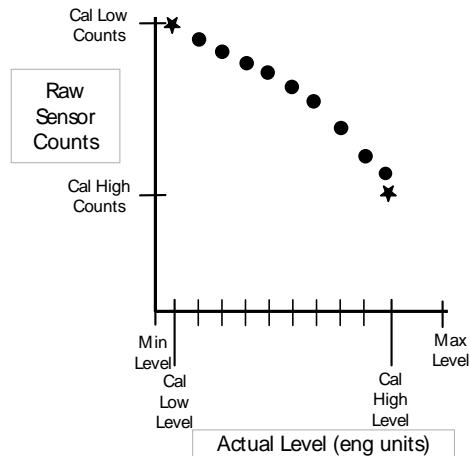


Figure 13: Linearizer data collected at various process levels

Internal software calculates a linearizer curve based on data points. The curve is the most accurate between the Cal Low Level and Cal High Level, as shown in Figure 16. For this reason, it is best to take the Cal Low and Cal High samples as close as possible to the Min Level and Max Level to maximize the accuracy within the span.

The linearizer curve maps on two axes so that it indicates % Count Range vs. % Span, as shown in Figure 14. To construct the linearizer table, a data point calculates for every 2.5% of the span. View or edit these points in the Linearizer table feature.

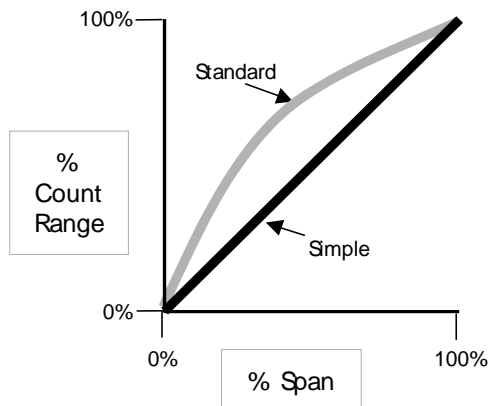


Figure 14: %Count range vs. %span (shown in linearizer table)

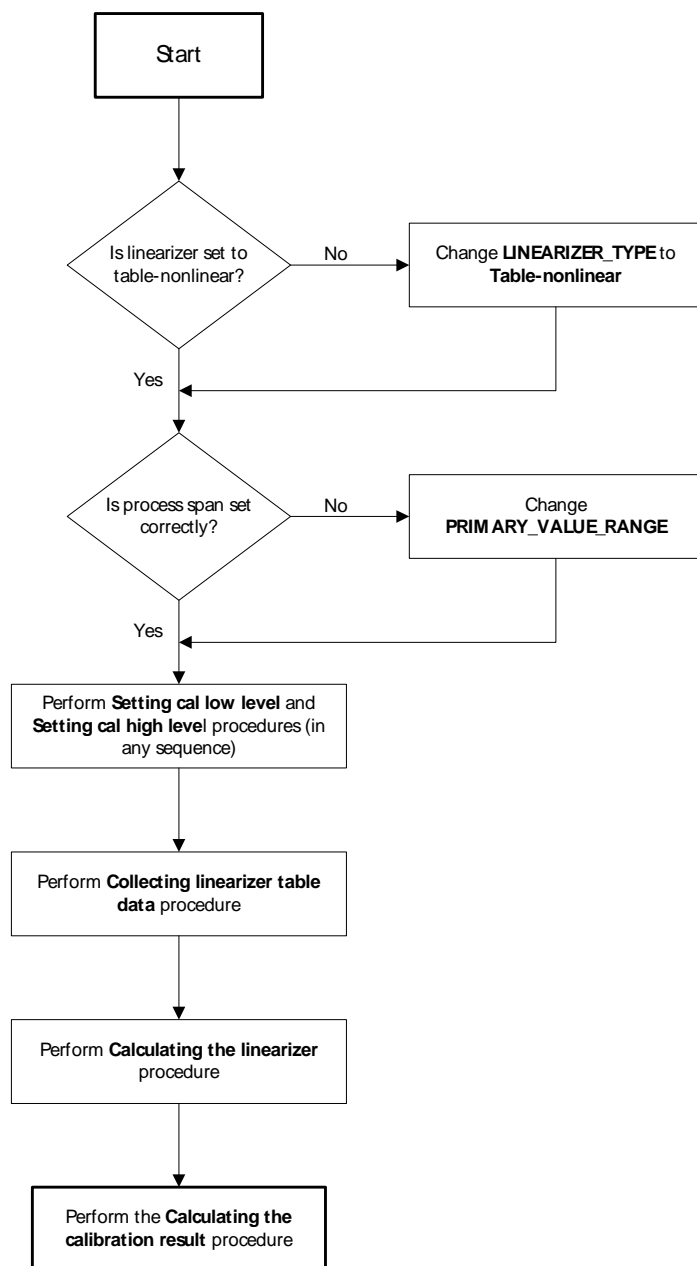


Figure 15: Standard method calibration flow chart

## Simple calibration method

The simple method of calibration does not require collection of intermediate data points.

Based on the Cal Low Level and Cal High Level, the internal software calculates a straight line between the Min Level and Max Level.

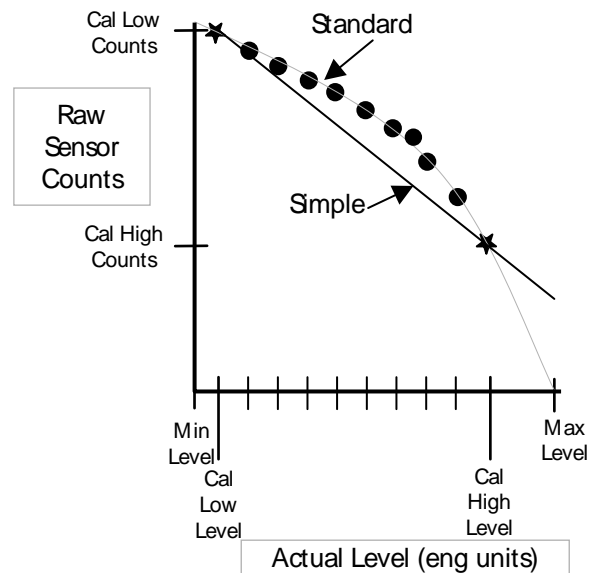


Figure 16: Raw counts vs. actual level with linearizers

The internal software calculates a straight line between the Min Level and Max Level based on the Cal Low Level and Cal High Level.

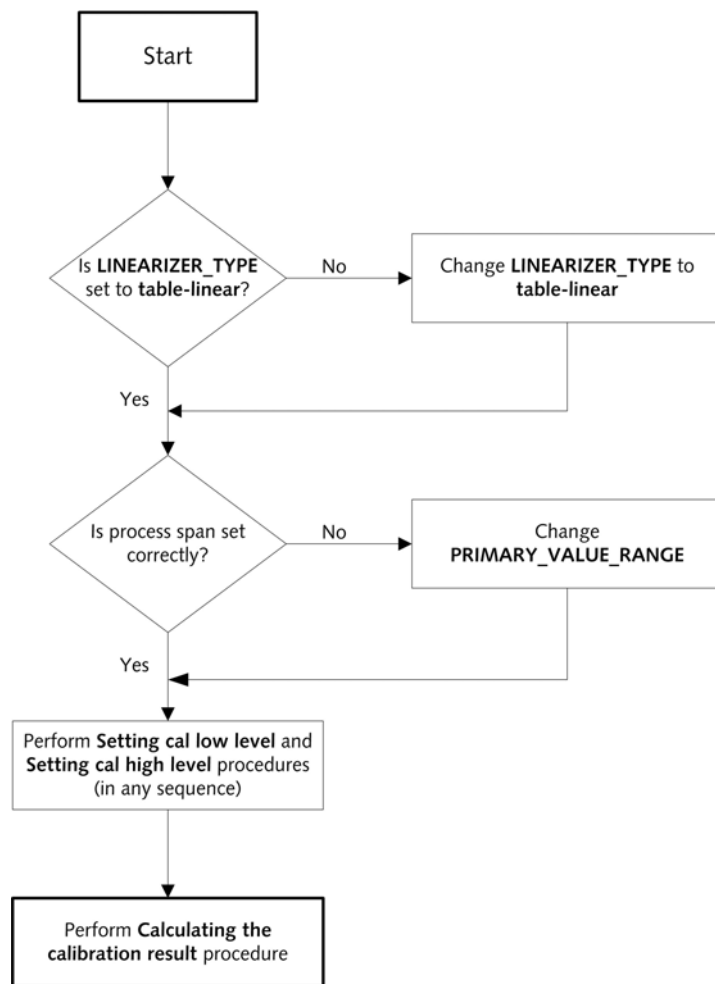


Figure 17: Simple method calibration flow chart

## Choosing the linearizer type

The level transmitter response curve is non-linear, due to the measurement method of radiation transmission. The linearizer determines the shape of the compensation curve between the endpoints.

As part of the signal processing necessary to produce a linear final output with respect to the change in level of process material, the level transmitter offers the following choices:

1. Non-linear table
2. Linear table

### Non-linear table

Use this option for a standard method calibration. The non-linear table is more accurate than the linear table. This is because the non-linear table takes into account the inherent non-linearity of a nuclear transmission measurement. The non-linear table can use data from linearizer look up table, data points that you collect and type during the calibration process

### Table, linear

Use this option for a simple method calibration. This option enables you to use a linear (straight-line) set of data for a linearizer look up table. You do not need to collect linearizer table data points. The straight-line linearizer calculates from the high and low-level calibration points. This requires you to perform the following:

- Two-point calibration
- Calculate the calibration

This is not as accurate because it does not compensate for the non-linearity of a radiation transmission measurement.

**Note:** If using the table-linear setting, ignore all entries in the **LINEARIZER\_PERCENT\_SPAN** tables. The gauge does not use these values.

## Choosing a linearizer method

*Procedure 9: To choose a linearizer method*

1. From **Setup TB 508** parameters list, select **LINEARIZER\_TYPE**
2. Click the scroll bar to see the choices
3. Select either **table-linear** or **table-nonlinear**.



## Checking the gauge repeatability

Check the level transmitter measurement repeatability before performing the calibration.

If using the menus interface, access the **Data collect** function from the **Calibrations** menu (Process TB 449) to enable simple measurement of the process, without altering the calibration or standardization values. It enables the system to measure the process and report the number of sensor counts. For more information about counts and the calculations performed to produce the final process value, see the “Process Chain” section in the “Advanced Functions” chapter.

You can perform a data collect three or four times on the same level to check the repeatability of the sensor. If the sensor counts vary widely, you should increase the Data collection interval parameter from the **Setup TB 508**. Refer to page 39 for further information.

### Performing a data collect

*Procedure 10: To perform a data collect*

1. In **Setup TB 508**, click **DATA\_COLLECT\_INTERVAL**
2. Type the number of seconds that the counts are averaged when calculating the calibration counts  
  
Usually this value is 60 seconds or greater
3. In **Setup TB 508**, select **DATA\_COLLECT\_EXECUTE** parameter, and select **execute data collect**  
  
The **TIME\_REMAINING** variable counts down until it reaches zero. This variable displays the number of seconds remaining for the data collect
4. View the **AVERAGE\_COUNTS** in the **Process TB 449**
5. Record the count for use in later procedures. See Table 6 on page 60.

## Calibrating the gauge

The standard calibration method involves five main steps:

1. Setting the low level and collecting Cal low data\*
2. Setting the high level and collecting Cal high data\*
3. Collecting linearizer data\*
4. Calculating the linearizer
5. Calculating the calibration

\*Perform these data collection steps in any sequence. Your ability to empty and fill the vessel determines the best sequence.

The simple calibration method skips Step 3 and 4.

If using the standard calibration method, you may find it helpful to record the sensor counts and levels at each step on Table 6.

*Table 6: Standard calibration sensor counts and levels record*

Data Point	Sensor counts	Actual level (eng units)
Cal low level (usually empty) Linearizer data point 0		
Linearizer data point 1		
Linearizer data point 2		
Linearizer data point 3		
Linearizer data point 4		
Linearizer data point 5		
Linearizer data point 6		
Linearizer data point 7		
Linearizer data point 8		
Linearizer data point 9		
Cal high level (usually full) Linearizer data point 10		

The two-point calibration can be performed from the **Process TB 449** parameters or from the **Process TB 449** main menu.

### Step 1: Set low level

Setting the low level for calibration requires the following activities

- Measurement with the level transmitter of the low process level
- Entry of the actual level

This sets the low end (sometimes referred to in the U.S. as “zero”) of the calibration curve. Perform this procedure either before or after setting the high level.

**Note:** You must perform data collection for the low and high level within ten days of each other for a good calibration. The low and high values must be more than 10 percent of the process span apart for the most accurate calibration.

Increasing the process span usually increases the gauge accuracy.

Before starting the cal low data collection:

- ☒ Fill vessel to its low level
- ☒ Have actual level value ready to enter

### Setting the cal low level

Perform the following procedure to set the cal low level the **Process TB 449** parameters.

*Procedure 11: To set the cal low level*

1. Complete the data collect procedure for the low level
2. In **Process TB 449**, select **CAL\_POINT\_LO\_COUNTS** and type the value of the **AVERAGE\_COUNTS** recorded for the cal low level
3. Select **CAL\_POINT\_LO** and type the process setting value.

### Step 2: Set high level

Setting the high level for calibration requires the following activities:

- Measurement with the level transmitter of the high process condition
- Entry of the actual level

This sets the “gain” of the calibration curve. Perform this procedure either before or after setting the low level.

**Note:** You must perform data collection for the low and high level within ten days of each other for a good calibration. The low and high values must be more than 10 percent of the process span apart for the most accurate calibration. Increasing the process span usually increases the gauge accuracy.

Before starting the cal high data collection:

- ☒ Fill vessel or pipe with high process, or close the source holder shutter to simulate high process
- ☒ Have actual level ready to enter

### Setting the cal high level

Perform the following procedure if you are using the **Process TB 449** parameters.

*Procedure 12: To set the cal high level*

1. Complete the data collect procedure for the high level
2. In **Process TB 449**, select **CAL\_POINT\_HI\_COUNTS** and type the **AVERAGE\_COUNTS** value
3. Select **CAL\_POINT\_HI** and type the process setting.

### Step 3: Collecting linearizer table data

**Note:** The simple method of calibration does not use this step.

The linearizer features are available from the **Diagnostics TB 569** parameters or the **Diagnostics TB 569** main menu, **CALIBRATION|LINEARIZER** menu if using a menus interface.

This step allows you to collect data points between the high and the low calibration points so that the VEGA level transmitter calculates a response curve based on your data.

Before collecting the linearizer table data:

- ☑ Prepare to set the level and take data. Eleven levels (including the Cal low and Cal high levels) are the maximum
- ☑ Prepare to enter the levels into the transmitter
- ☑ You can collect linearizer table data along with the data collection for the Cal low and Cal high levels

## Collecting linearizer table data

*Procedure 13: To collect linearizer table data*

1. In **Setup TB 508**, select **LINEARIZER\_TYPE**
2. Select **table-nonlinear**
3. In **Diagnostics TB 569**, view **LINEARIZER\_COUNTS** and **LINEARIZER\_VALUE** parameters to verify the entries  
  
If the entries are invalid, select **DELETE\_ALL\_DATA\_POINTS** from **Diagnostic TB 569** list and choose **delete all data points**  
  
This parameters automatically reverts back to idle
4. In **Diagnostic TB 569**, select **LINEARIZER\_SAVE\_DATA**
5. In **Diagnostic TB 569**, select **Reset to Saved Values**  
  
This parameter automatically reverts back to **idle**
6. In **Diagnostic TB 569**, read the **LINEARIZER\_COUNTS** and **LINEARIZER\_VALUE** arrays  
  
Each of these arrays contain 11 entries (each element of the **LINEARIZER\_VALUE** array has a corresponding **LINEARIZER\_COUNTS** element)
7. In **Diagnostic TB 569**, select **LINEARIZER\_COUNTS**
8. In **Process TB 449**, select **COUNTS\_LOW** and type the value into the first entry
9. In **Diagnostic TB 569**, select the first entry of **LINEARIZER\_VALUE** and type the 0% of span value
10. In **Diagnostic TB 569**, select the second entry of **LINEARIZER COUNTS**
11. In **Process TB 449**, select **COUNTS\_HIGH VALUE** and type the value into the first entry
12. In **Diagnostic TB 569**, select the second entry of **LINEARIZER\_VALUE** and type the 100% of span value
13. Perform the data collect procedure on page 59 to get the average counts for a new process level setting
14. In **Diagnostic TB 569**, select the third entry of **LINEARIZER\_COUNTS**

*Procedure 13: To collect linearizer table data continued)*

15. In **Process TB 449**, select **AVERAGE\_COUNTS** and type the value of the new data collect
16. In **Diagnostic TB 569**, select the third entry of **LINEARIZER\_VALUE** and type the process span value
17. Repeat steps 11 through 16 until you have the desired number of linearizer data points
18. In **Diagnostic TB 569**, select **LINEARIZER\_NUM\_POINTS** and type the number of **LINEARIZER\_COUNTS** entries
19. In **Diagnostic TB 569**, select **LINEARIZER\_SAVE\_DATA** and select **Save Current Value**.

**Note:** Include the data for the Cal low and Cal high with the linearizer data before you perform Calculate linearity. If you did not perform a linearizer data collect while the process was at the levels for Cal low and Cal high, you can manually add those values to the linearizer data.

To add a data point to the linearizer data, you must know the level in engineering units and the sensor counts.

### Step 4: Calculating the linearity

**Note:** The simple method of calibration does not use this step.

After collecting the data for a linearizer table, the transmitter uses the data to calculate a new calibration linearizer table. The **Calculate Linearity** function initiates this calculation. You must perform this step before the Calculate Calibration step, described in the next section.

### Calculating a new linearizer table

You can calculate the linearizer table using the **Diagnostic TB 569** parameters.

Calculate the linearizer after you perform the following steps:

- ☒ Select non-linear table for the linearizer curve
- ☒ Collect linearizer data

#### *Procedure 14: To calculate the linearizer*

1. In **Diagnostics TB 569**, select **CALCULATE\_LINEARITY\_NOW** and choose **calculate linearity now**

This parameter automatically reverts back to **not calculating linearity** when complete

2. In **Diagnostics TB 569**, select **LINEARIZER\_PERCENT\_SPAN\_1** and **LINEARIZER\_PERCENT\_SPAN\_2** parameter to view the values.

This displays the new 41-point linearizer table that is in use by the gauge.



### Step 5: Calculate calibration

After collecting the high and low level calibration data and calculating the linearity, the level transmitter is ready to make the calibration calculation. Calculate the calibration using the **Process TB 449** parameter list.

#### Calculating the calibration result

*Procedure 15: To calculate the calibration results*

1. From **Process TB 449**, select **CALCULATE\_CALIBRATION\_NOW**  
  
This variable automatically reverts back to **no calibration calculation** after the calibration recalculation
2. Select **COUNTS\_LOW** and **COUNTS\_HIGH** to see if the calibration results are good.

# When a new calibration may be necessary

Under most circumstances, you do not need to repeat the calibration procedure. The system requires only periodic standardization to compensate for drifts over time. However, certain events necessitate a new calibration. The events are:

- Measurement of a new process application (contact VEGA for recommendations)
- Process requires a new measurement span
- Entry of a new measurement span setting into the software
- Installation of a new radiation source holder
- Moving the level transmitter to another location (in U.S. only specifically licensed persons may relocate the gauge)
- Changes to the process vessel, for example: lining, insulation, or agitator
- Excessive build up or erosion of vessel that standardization cannot compensate for (check standardize gain)
- Standardize gain is greater than 1.2 after a standardization, indicating it made a 20% adjustment from the calibration

## Periodic process standardization

Standardization adjusts the system by resetting one point of the calibration curve to an independently measured or known level.

The frequency of standardization depends on several factors, including desired accuracy of the reading.

During the standardization procedure, the system displays either:

- A default value for the standardization condition
- A prompt to enter the actual level of the standardization condition

Chapter 4: LFXG-D Setup details how to set up the software for either prompt.

## Automatic standardization reminder

If you enable the standardization due alarm, the level transmitter alarms when standardization is due. The standardize interval is programmed into the calibration parameters setup. Refer to Chapter 4: LFXG-D setup for details on the following subjects:

- Output relay setup
- Standardization due alarm
- Standardization interval

## Performing a standardization

### Standardizing the gauge

- ☑ Setup the Standardize Type according to the procedure on 38.

*Procedure 16: To standardize the gauge*

1. From **Setup TB 508**, select **DATA\_COLLECT\_INTERVAL**
2. Type the number of seconds that the counts are averaged when calculating the calibration counts  
  
Usually this value is 60 seconds or greater
3. Select **DATA\_COLLECT\_EXECUTE**, and select **execute data collect**
4. The **TIME\_REMAINING** variable counts down until it reaches zero. This variable displays the number of seconds remaining for the data collect
5. From **Process TB 449**, select **AVERAGE\_COUNTS** and view the value
6. From **Setup TB 508**, select the **STANDARDIZE\_COUNTS** parameter
7. From **Process TB 449**, select **AVERAGE\_COUNTS** and type in the value
8. Write the new information to the host system
9. From **Process TB 449**, select the **STANDARDIZE\_GAIN** parameter and read the value.  
  
If the value is greater than 1.2 then you may need to perform a new two-point calibration.

Notes

# Chapter 6: Advanced functions

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Most functions not required for normal operation of the transmitter are found in the menu structure under the, **Advanced Functions**. If you are not using the menus interface, these options are available through the transducer block parameters. These functions are primarily for use by VEGA personnel for advanced troubleshooting and repair. This chapter gives a basic explanation of these functions.

**Note:** VEGA strongly recommends that you ask our advice before using any of these advanced functions.

Advanced functions includes the following features:

- Process chain
  - Primary channel
  - Process variables
  - Aux channel
- Min/Max history
  - Primary counts
  - Secondary counts
  - Sensor temperature
- New hardware
  - New CPU
  - No new hardware
- Test mode
  - Sensor test
  - Auxiliary input test
  - Relay test mode
  - Temperature test mode

- Other advanced functions
  - High voltage monitor
  - Firmware version
  - Hardware version
  - CPU serial number
  - Sensor serial number
  - Sensor temperature coefficients
  - Sensor location

## Process chain

The process chain is a description of the transmitter software's calculation of a level measurement from a radiation reading. Use the **Process TB 449 Advanced Functions|Process chain** submenu or the specific transducer block parameters to view intermediate values of the calculation to verify proper functionality of the software.

## Primary channel

Use the **Advanced Functions|Process chain|Primary channel** or the transducer block parameters to view the following parameters:

- Sensor temp
- Sensor counts
- Temp comp counts
- Raw counts
- Adjusted counts
- Source decay
- STDZ counts
- % count range
- % process span
- Level
- Final level

### Sensor temp

**TEMPERATURE\_VALUE.** Displays the internal probe's measurement of the sensor temperature.

## Sensor counts

**PRIMARY\_RAW\_COUNTS.** Displays the sensor counts that are true counts that are output from the sensor, before application of the following:

- Temperature compensation
- Standardize
- Sensor uniformity gains

## Temp comp counts

**TEMP\_COMP\_VALUE.** Displays temperature compensated counts that are sensor counts with application of sensor temperature compensation.

## Raw counts

**UNIFORMITY\_GAIN\_COUNTS.** Displays raw counts that are temperature compensated counts with application of uniformity gain.

## Adjusted counts

**SUMMATION\_COUNTS.** Displays adjusted or sum counts that are raw counts plus auxiliary raw counts. In most applications that do not use auxiliary input, sum counts are equal to raw counts.

## Source decay counts

**SOURCE\_DECAY\_COUNTS.** Displays source decay counts that are sum counts with application of source decay gain.

## Stdz counts

**STANDARD\_COUNTS.** Displays standardize counts that are source decay counts with application of standardization gain.

### % count range

**COUNT\_RANGE\_PERCENT.** Displays compensated measurement counts expressed as a percent of the counts at the high and low-endpoints of the calibration (determined with the two point calibration.) This quantity shows where the current measurement is in relation to the total count range.

$$\% \text{ count range} = 100 \times (C_L - C_S) / (C_L - C_H)$$

where

$C_S$  = STDZ\_COUNTS

$C_L, C_H$  = counts at Cal low level and Cal high level

$C_L - C_H$  = counts range

### % Process Span

**PERCENT\_SPAN.** Displays the measurement value as a percent of the measurement span. The maximum and minimum level values are input in the **Setup** parameters. A graph of percent count range vs. percent process span indicates the non-linearity of the radiation transmission measurement. If using a table linearizer, the values in the table are percent count range and percent process span.

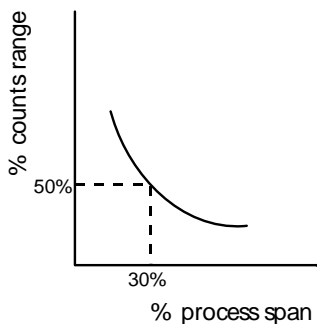


Figure 18: % counts range vs. % process span

### Level

**UNFILTERED\_VALUE.** Displays the level in inches without the time constant or rectangular window filter.

### Final level

**PRIMARY\_VALUE.** Displays the process value that is the level or other indication in engineering units, after applying the filter.



## Viewing the primary channel parameter values

*Procedure 17: To view primary channel values*

1. From **Process TB 449**, select the following parameters:
  - **TEMPERATURE\_VALUE**
  - **PRIMARY\_RAW\_COUNTS**
  - **TEMP\_COMP\_VALUE**
  - **UNIFORMITY\_GAIN\_COUNTS**
  - **SUMMATION\_COUNTS**
  - **SOURCE\_DECAY\_COUNTS**
  - **STANDARD\_COUNTS**
  - **COUNT\_RANGE\_PERCENT**
  - **PERCENT\_SPAN**
  - **UNFILTERED\_VALUE**
  - **PRIMARY\_VALUE**
2. The values for each parameter displays.

## Process variables

Use the **Process TB 449** parameters to verify proper functionality of the software.

The Process Variable feature displays the following values:

- Counts low
- Counts high
- Cal high point
- Cal low point
- Temperature compensation gain
- Source decay gain
- Standardize gain

### Counts low

**COUNTS\_LOW**. Displays the sensor counts at the minimum level.

### Counts high

**COUNTS\_HIGH**. Displays the sensor counts at the maximum level.

### Cal high point

**CAL\_POINT\_HI**. Displays the maximum level that is the value, in process units, as entered in the TB parameters. Use this to calculate the measurement span.

### Cal low point

**CAL\_POINT\_LO**. Displays the minimum level that is the value, in process units, as entered in **TRANSDUCER BLOCK** parameters. Use this to calculate the measurement span.

### Temp comp gain

**TEMP\_COMP\_GAIN**. Displays the gain term applied to the raw sensor counts. Use this to adjust for inherent sensor output change with temperature.

### Source decay gain

**SOURCE\_DECAY\_GAIN**. Displays the current value of the source decay gain. Use this to compensate for the natural decay of the radiation source that produces a lower field over time.

## Standardize gain

**STANDARDIZE\_GAIN.** Displays the current value of the standardize gain that adjusts with each standardize procedure.

*Procedure 18: To view process variables*

1. From **Process TB 449**, select one of the following parameters:
  - **COUNTS\_LOW**
  - **COUNTS\_HIGH**
  - **CAL\_POINT\_HI**
  - **CAL\_POINT\_LO**
  - **TEMP\_COMP\_GAIN**
  - **UNIFORMITY\_GAIN**
  - **SOURCE\_DECAY\_GAIN**
  - **STANDARDIZE\_GAIN**
  - **HIGH\_VOLTAGE\_SETTING**
2. From **Diagnostics TB 569**, select **UNIFORMITY\_GAIN**
3. View the process variable parameter value fields.

## Aux channel chain

The display values for the auxiliary channel chain parameters are:

### Aux counts

**SECONDARY\_RAW\_COUNTS**. Displays the frequency-input counts from optional auxiliary input.

### Aux filtered counts

**SECONDARY\_COUNTS**. Displays the filtered auxiliary counts. The filter dampening value is the number to enter for the auxiliary input filter time constant.

*Procedure 19: To view the auxiliary channel chain parameters*

1. From **Process TB 449**, select **SECONDARY\_RAW\_COUNTS**
2. From **Diagnostic TB 569**, select **SECONDARY\_COUNTS**
3. View the auxiliary channel chain parameters value fields.

## Min/Max history

The min/max history displays the minimum and maximum value for parameters since the last min/max reset. The display values are:

- Primary counts
- Secondary counts
- Sensor temperature
- Last reset

### Primary counts

**MIN\_PRIMARY\_COUNTS** and **MAX\_PRIMARY\_COUNTS**. Displays raw uncompensated counts from the detector.

### Secondary counts

**MIN\_SECONDARY\_COUNTS** and **MAX\_SECONDARY\_COUNTS**. Displays auxiliary input (if used) counts.

### Sensor temp

**MIN\_SENSOR\_TEMP** and **MAX\_SENSOR\_TEMP**. Displays the internal temperature of the scintillator sensor in the LFXG-D model level transmitter.

### Last reset

**LAST\_RESET**. Displays the date and time of the last history reset.

## Viewing the minimum and maximum history

*Procedure 20: To view the minimum and maximum history*

1. From **Diagnostic TB 569**, select the following:
  - **MIN\_PRIMARY\_COUNTS**
  - **MAX\_PRIMARY\_COUNTS**
  - **MIN\_SECONDARY\_COUNTS**
  - **MAX\_SECONDARY\_COUNTS**
  - **MIN\_SENSOR\_TEMP**
  - **MAX\_SENSOR\_TEMP**
  - **LAST\_RESET**
2. View the minimum and maximum history parameters value fields.

## Resetting the minimum and maximum history

You can reset the minimum and maximum history values so that they record from the time of the reset.

*Procedure 21: To reset the minimum and maximum history*

1. From **Diagnostic TB 569**, select the **RESET\_MIN\_MAX\_HISTORY**  
The following choices are available:
  - **idle**
  - **execute**
2. Select **execute**.  
After selecting execute the date of the reset is recorded in the **LAST\_RESET** parameter and the **RESET\_MIN\_MAX\_HISTORY** value returns to idle.

## New hardware or EEPROM corrupt

The transmitter contains two electrically erasable programmable read only memory (EEPROM) chips. The EEPROMs store all data specific to that sensor/electronics pair for the installation. The locations of the EEPROMs are:

- On the CPU board
- On the sensor board

Each EEPROM contains a backup of the other EEPROM. The system monitors both EEPROMs at power-up to assure an accurate backup.

If you install a new CPU board, the EEPROM backups on the CPU and sensor boards do not match. The software signals the discrepancy with the error message, New Hardware Found. The transmitter does not automatically perform a backup in case the discrepancy is not due to new hardware, but some corruption of the EEPROM.

**Note:** Only use the **New Hardware** functions if you replace the CPU board or receive an corrupt EEPROM message.

This function is not necessary if installing a completely new detector assembly. The new detector assembly includes the CPU board and the sensor assembly.

### Proper response to "New hardware found" message if new hardware has been installed

When you install a new CPU board, you must verify installation in the **Diagnostics TB 569** parameters. This function enables new backups of the EEPROMs.

#### If a new CPU board has been installed

*Procedure 22: To acknowledge new hardware found message with new CPU board*

1. From **Diagnostic TB 569**, select **COPY\_NV\_MEMORY**
2. Select **sensor main→cpu backup**
3. Wait 60 seconds for the transfer to complete.

## Proper response to "New hardware found" message if new hardware has not been installed

### CPU EEPROM Corrupt message or Sensor EEPROM Corrupt message

If there has not been an installation of a new CPU board and the error message, New Hardware Found, displays, then one of the EEPROMs is probably corrupt. You normally can repair the corruption with the EEPROM backup.



#### **CAUTION!**

If you suspect that an EEPROM is corrupt, we recommend you call VEGA Field Service for advice before performing the following procedure.

### To repair the corruption from the EEPROM backup

*Procedure 23: To repair corrupted EEPROM*

1. From **Diagnostic TB 569**, select **COPY\_NV\_MEMORY**
2. Select **main mems→backup mems**
3. Wait 60 seconds for the transfer to complete.

# Test modes

Four independent test modes are available. These test modes are:

1. Sensor
2. Auxiliary
3. Relay
4. Temperature

In the test modes, the transmitter stops measuring the process material and allows manual adjustment of critical variables for troubleshooting. The test modes enable independently. However, you can use them in combination to test multiple variable effects. All of the test modes time out automatically after one hour if you do not manually exit.

To use the test modes, the **Diagnostic TB 569** must be in Out of Service (OoS) mode. Once the gauge is in test mode, the **Diagnostic TB 569** can be placed back into automatic (AUTO) mode.



### CAUTION!

While in a test mode, the transmitter is not measuring process and so its primary value does not reflect the process value. Be sure to remove the system from automatic control before entering or exiting a test mode.



### Sensor test mode

The sensor test mode simulates the sensor output at a user-defined number of raw counts. This is before application of the following:

- Temperature compensation
- Sensor uniformity gain
- Standardize gain

The true sensor output is ignored while the transmitter is in sensor test mode.

Sensor test mode is extremely useful for verifying the electronics and software response to input counts without having to perform the following:

- Change the process
- Shield the source
- Vary the radiation field

While in sensor test mode, after entering the desired number of counts, it may be useful to look at the **Process chain** parameters to view the variables affected by the raw counts value. To view the **Process chain** parameters refer to page 72. The transmitter continues to operate in sensor test mode until it times out after one hour or until you choose **Exit test mode**.

### Starting sensor test mode

*Procedure 24: To start sensor test mode*

1. From **Diagnostic TB 569**, select **SENSOR\_TEST\_MODE**
2. Select **In test mode**
3. From **Diagnostic TB 569**, select **PRIMARY\_RAW\_COUNTS** to write the test mode counts.

### Exit sensor test mode

*Procedure 25: To exit sensor test mode*

1. From **Diagnostic TB 569**, select **SENSOR\_TEST\_MODE**
2. Select **Normal mode**.

### Auxiliary input test mode

The auxiliary input test mode simulates the auxiliary input frequency at a user-defined number of counts. The effect of auxiliary input counts depends on the auxiliary input mode. Examples are:

- Temperature probe
- Flow meter
- Second transmitter

While in auxiliary input test mode, after you enter the desired number of counts, it may be useful to look at the **Process chain** screen to view the variables affected by the auxiliary input counts value. To view the **Process chain** parameters, refer to page 72. The transmitter continues to operate in auxiliary input test mode until it times out after one hour or until you choose **Exit auxiliary input test mode**.

### Start auxiliary input test mode

*Procedure 26: To start auxiliary test mode*

1. From **Diagnostic TB 569**, select **SECONDARY\_TEST\_MODE**
2. Select **In test mode**
3. From **Diagnostic TB 569**, write the test mode counts to variable **SECONDARY\_COUNTS**.

### Exit auxiliary input test mode

*Procedure 27: To exit auxiliary test mode*

1. From **Diagnostic TB 569**, select **SECONDARY\_TEST\_MODE**
2. Select **Normal mode**.

## Relay test mode

Relay test mode enables the user to manually toggle the relay on or off to test the contacts. This is useful for verifying the functioning of alarm annunciators.

### Start relay test mode

*Procedure 28: To start relay test mode*

1. From **Process TB 449**, select **RELAY\_STATUS\_TEST**
2. Type **1** to energize or **2** to de-energize and click **OK**.

### Exit relay test mode

*Procedure 29: To exit relay test mode*

1. From **Process TB 449**, select **RELAY\_STATUS\_TEST**
2. Type **0** and click **OK** to exit test mode.

## Temperature test mode

The temperature test mode enables the user to manually force the LFXG-D sensor temperature probe output to a specified value. This is useful for verifying the scintillator sensor temperature compensation.

### Starting temperature test mode

*Procedure 30: To start temperature test mode*

1. From **Diagnostic TB 569**, select **TEMPERATURE\_TEST\_MODE**
2. Select **In test mode**
3. Select **TEMPERATURE\_VALUE**
4. Type in the new temperature value.

### Exit temperature test mode

*Procedure 31: To exit Temperature test mode*

1. From **Diagnostic TB 569**, select **TEMPERATURE\_TEST\_MODE**
2. Select **Normal mode**.

## Other advanced functions

When performing diagnostics, it may be important to know the following information:

- Sensor voltage (high voltage monitor)
- Version of firmware on the FLASH installed on the level transmitter
- Hardware version number
- CPU serial number
- Sensor serial number
- Sensor temperature coefficients
- Sensor location

### Sensor voltage

**HIGH\_VOLTAGE\_MONITOR.** Displays the scintillator sensor voltage.

### Firmware version

**FIRMWARE\_VERSION.** Displays the firmware version number.

### Hardware version

**HARDWARE\_VERSION.** Displays the hardware version number.

### CPU serial number

**CPU\_SERIAL\_NUMBER.** Displays the CPU serial number.

### Sensor serial number

**SENSOR\_SERIAL\_NUMBER.** Displays the sensor serial number.

### Sensor temperature coefficients

**SENSOR\_TEMP\_COEFF0, SENSOR\_TEMP\_COEFF1, SENSOR\_TEMP\_COEFF2, SENSOR\_TEMP\_COEFF3.** The algorithm that compensates for variations in measurement output with changes in temperature uses temperature coefficients. The VEGA factory determines the coefficients through rigorous testing. You cannot change these values through normal operation.

### Sensor location

**SENSOR\_LOCATION.** The local gauge refers to a gauge that has its sensor electronics and processing electronics all contained in the same housing. Set a gauge to remote if the sensor electronics and processing electronics are in separate housings and the process signal connects to the auxiliary input of the processing electronics.

*Procedure 32: To view other advanced functions*

1. From **Diagnostic TB 569**, select one of the following parameters:
  - **HIGH\_VOLTAGE\_MONITOR**
  - **FIRMWARE\_VERSION**
  - **HARDWARE\_VERSION**
  - **CPU\_SERIAL\_NUMBER**
  - **SENSOR\_SERIAL\_NUMBER**
2. From **Setup TB 508**, select one of the following parameters:
  - **SENSOR\_TEMP\_COEFF0**
  - **SENSOR\_TEMP\_COEFF1**
  - **SENSOR\_TEMP\_COEFF2**
  - **SENSOR\_TEMP\_COEFF3**
  - **SENSOR\_LOCATION**
3. View the parameter value field.

## Select gauge type

VEGA's nuclear density gauges use much of the same hardware and software as the VEGA Level transmitters. If your level transmitter indicates PV or Density as the process variable, it was set incorrectly for a level type application. Select gauge type enables the users to set the software to operate as either a density or a level gauge.

*Procedure 33: To select gauge type*

1. From the **Process TB 449**, select **DEVICE\_SELECT**
2. Select **Level**
3. In order to have the proper gauge DD running, remove the VEGA gauge from the host device list and then re-initialize the gauge with the host
4. Verify that the correct DD is operating by selecting the gauge **RESOURCE\_BLOCK** and view the **MANUFAC\_ID** parameter. The parameter value should say **VEGA Level**.

# Chapter 7: Diagnostics and repair

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## Software diagnostics

The level transmitter system can alert users to potential problems by:

- Posting messages on the screen
- Tracking the current status and history in the Status feature

Three classes of alarms are available to track the status and history in the Status feature. These alarms are:

1. Diagnostic
2. Process
3. X-ray

### **Diagnostic alarm**

The diagnostic alarm feature provides information about the level transmitter system and alerts the user when periodic procedures are due.

### **Process alarm**

The process alarm enables an alert to be generated when the process level is either above or below the process span.

## X-ray alarm

The x-ray alarm feature generates an alarm when the gauge detects a large increase in the radiation field. This prevents control problems when external radiographic sources are in the area for vessel inspections.

Table 7 is a summary of the alarm-type outputs.

*Table 7: Alarm type outputs*

Error	XD_ERROR	DEVICE_ERROR	PRIMARY_VALUE Status
RAM corrupt (LSB)	Memory Failure	RAM Corrupt	Uncertain
Sensor EEPROM corrupt	Lost Static Data	Sensor EEPROM Corrupt	Uncertain
FLASH corrupt	Memory Failure	FLASH Corrupt	Uncertain
Real time clock fail	Electronics Failure	Real time clock fail	Uncertain
Internal temperature sensor failure	Device Needs Maintenance Now	Internal temperature sensor failure	Uncertain
Standardize due	Device Needs Maintenance Soon	STDZ due	Unaffected
Source wipe due	Device Needs Maintenance Soon	Source wipe due	Unaffected
X-ray detected	Input Failure	X-ray detected	Uncertain
CPU EEPROM corrupt	Lost Static Data	CPU EEPROM corrupt	Uncertain
Shutter check due	Device Needs Maintenance Soon	Shutter check due	Unaffected
New hardware/new CPU	Device Needs Maintenance Now	New Hardware/New CPU	Uncertain
Calibration error	Calibration Error	Calibration Error	Uncertain
Sensor fail	Electronics Failure	Sensor Fail	Uncertain
Process out of measurement range	00	Process out of measurement range	Bad
Sensor high voltage fail	Electronics Failure	Sensor high voltage fail	Uncertain



## Status

Use **Diagnostic TB 569** to check status and historical information.

### Diagnostic alarms and fieldbus messages

Diagnostic conditions that are *currently* in alarm alert the user by two possible means:

1. Diagnostic history parameters from the **Diagnostics TB 569** parameters.
2. Fieldbus messages that appear when a fieldbus device connects if the alarm is setup

**Note:** Refer to the table on page 92 for a summary of all diagnostic alarm conditions and recommended actions.

### Status diagnostics

To check the status of the system you can use the **Diagnostic History** parameters (refer to page 95). These parameters only indicate the status; historical occurrences are stored in the **Min/Max History** parameters.

Some conditions are self-repairing, for example RAM and EEPROM corruption. Therefore, these may appear in the history screens but not in the diagnostic screens.

## Summary of diagnostic alarm conditions

Table 8: Diagnostic alarm conditions

Device error conditions	Diagnostic description	Action
RAM Corrupt	RAM memory corruption occurred and resolved internally. Repeated triggering of alarm suggests hardware problem.	Consult VEGA Field Service.
Sensor EEPROM Corrupt	A critical memory corruption occurred on the sensor pre-amp board EEPROM that may not be resolved internally.	If it persists, contact VEGA Field Service for advice.
Flash Corrupt	Checksum error detected in the Flash ROM memory	Contact VEGA Field Service.
Real Time Clock Fail	The clock stopped. This can cause a miscalculation of timed events.	Contact VEGA Field Service if the clock does not run to get firmware version 2200.06 or higher.
Internal Temperature Sensor Failure	The sensor temperature probe may not be functioning, which results in erroneous measurements.	Verify the sensor temperature. If the temperature reads -0.5 °C constantly, the probe may be broken and the CPU board may need replacement. Contact VEGA Field Service.
Source Wipe Due	According to your initial setup, it is time to perform a source wipe.	Log a shutter check in Diagnostics TB 569 parameters list.
CPU EEPROM Corrupt	A critical memory corruption occurred on the CPU board EEPROM that may not be resolved internally. If the alarm recurs, there is a hardware problem.	To check for recurrence, cycle the power to the unit. If it persists, contact VEGA Field Service for advice.
Sensor Fail	Less than 1 count seen in the last 10 seconds (configurable by Field Service.) Indicates the sensor is malfunctioning.	Contact VEGA Field Service.
Sensor High Voltage Fail	Sensor high voltage fail/High voltage on the PMT is outside the usable range.	Contact VEGA Field Service.
Standardize Due	According to your initial setup, it is time to perform standardization.	Perform a new standardization procedure.
Shutter Check Due	According to your initial setup, it is time to perform a shutter check.	Perform a shutter check. Acknowledge record shutter check-new in the Diagnostics Transducer Block parameters list.
New Hardware / New CPU Found	The CPU board detects a configuration mismatch. The CPU board or sensor assembly may have been replaced or one of the EEPROM configurations is incorrect.	Contact VEGA Field Service first. If they concur, identify the new hardware using the Diagnostics TB 569 parameter list.
Process Out of Range	The current process value is not within the limits set by the Max level and Min level in the gauge span settings.	Contact VEGA Field Service.
X-Ray Detected	Note that there are high levels of x-ray radiation in your area that can affect your process measurement.	Contact VEGA for further information.
Command Failure	Power was cycled on the gauge electronics but not to the Fieldbus network.	Acknowledge alarm in the Diagnostics TB (TB 569) parameter list. Set the HART-Info parameter to 1, apply changes.

## Process alarm

The process alarm alerts users when the process level is above or below the process span.

The process alarm works only with the output relay. No fieldbus messages, gauge status diagnostics, or history information saves for the process alarms.

The level transmitter acknowledges or resets the process alarm when the process value returns back to within span. Depending on your usage of the process alarm relay, you may want to install a process alarm override switch to manually turn off an annunciator when the level transmitter relay energizes.

## X-ray alarm

The x-ray alarm compensates for false indicated process values that occur when the gauge detects external radiographic sources. For example, vessel weld inspections often use portable radiographic (x-ray) sources. X-rays that the gauge detects cause a false low reading and adversely affect any control based on the gauge output.

The x-ray alarm can alter the output to indicate the alarm condition.

The level transmitter enters the x-ray alarm condition when it detects a radiation field above a set threshold. The gauge sets the output to its value 10 seconds before the condition. The **PRIMARY\_VALUE** status is set to **uncertain** and the **DEVICE\_ERROR** is set to **X-ray detected**. The **XD\_ERROR** parameter is set to **Input Failure**.

The standard x-ray alarm only triggers when the counts are greater than the cal low count value. These counts are found on the process variable menu. If the x-ray source is setup so that the counts increase but do not go above the cal low counts, the x-ray alarm does not trigger and the gauge reads the x-ray interference as a true process shift.

## History information

You can use the transducer block parameters to view the following critical events.:

- RAM corrupt
- Sensor EEPROM corrupt
- FLASH corrupt
- Real time clock fail
- Sensor temperature fail
- Standardize due
- Source wipe due
- New hardware found
- Alarm Type 3
- CPU EEPROM
- Alarm Type 1
- Alarm Type 2
- Shutter check due
- Sensor fail
- Process out of range
- Sensor voltage out of spec

Use this information to determine if a problem has recently occurred and internally repaired. An example of this would be an EEPROM corruption.

## Viewing diagnostic history

Use the Diagnostic History parameters and sub-parameters to view the most recent and oldest dates of critical events.

### Procedure 34: To view diagnostic alarms

1. From **Diagnostics TB 569**, select **DIAG\_HISTORY\_NEWEST\_1**

The sub-parameters display the following diagnostic errors:

Sub-parameter	Description
DIAG_HISTORY_NEWEST_1	RAM corrupt
DIAG_HISTORY_NEWEST_1	Sensor EEPROM corrupt
DIAG_HISTORY_NEWEST_1	FLASH corrupt
DIAG_HISTORY_NEWEST_1	Real time clock fail
DIAG_HISTORY_NEWEST_1	Sensor temp fail
DIAG_HISTORY_NEWEST_1	Standardize due
DIAG_HISTORY_NEWEST_1	Source wipe due
DIAG_HISTORY_NEWEST_1	New hardware found

2. From **Diagnostics TB 569**, select **DIAG\_HISTORY\_NEWEST\_2**

The sub-parameters display the following diagnostic errors:

Sub-parameter	Description
DIAG_HISTORY_NEWEST_2	Alarm Type 3
DIAG_HISTORY_NEWEST_2	CPU EEPROM
DIAG_HISTORY_NEWEST_2	Alarm type 1
DIAG_HISTORY_NEWEST_2	Alarm type 2
DIAG_HISTORY_NEWEST_2	Shutter check due
DIAG_HISTORY_NEWEST_2	Sensor fail
DIAG_HISTORY_NEWEST_2	Process out of range
DIAG_HISTORY_NEWEST_2	Sensor voltage out of spec

3. From **Diagnostics TB 569**, select **DIAG\_HISTORY\_OLDEST\_1**

Sub-parameter	Description
DIAG_HISTORY_OLDEST_1	RAM corrupt
DIAG_HISTORY_OLDEST_1	Sensor EEPROM corrupt
DIAG_HISTORY_OLDEST_1	FLASH corrupt
DIAG_HISTORY_OLDEST_1	Real time clock fail
DIAG_HISTORY_OLDEST_1	Sensor temp fail
DIAG_HISTORY_OLDEST_1	Standardize due
DIAG_HISTORY_OLDEST_1	Source wipe due
DIAG_HISTORY_OLDEST_1	New hardware found

4. From **Diagnostics TB 569**, select **DIAG\_HISTORY\_OLDEST\_2**.

Sub-parameter	Description
DIAG_HISTORY_OLDEST_2	Alarm Type 3
DIAG_HISTORY_OLDEST_2	CPU EEPROM
DIAG_HISTORY_OLDEST_2	Alarm type 1
DIAG_HISTORY_OLDEST_2	Alarm type 2
DIAG_HISTORY_OLDEST_2	Shutter check due
DIAG_HISTORY_OLDEST_2	Sensor fail
DIAG_HISTORY_OLDEST_2	Process out of range
DIAG_HISTORY_OLDEST_2	Sensor voltage out of spec

## Hardware diagnostics



### Special installation, maintenance, or operating instructions

If it is necessary to open the sensor, the following warning applies:

**EXPLOSION HAZARD** - Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

**AVERTISSEMENT: - RISQUE D'EXPLOSION** - AVANT DE DÉCONNECTER L'ÉQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

### CAUTION!

Open circuits before removing cover. An explosion-proof seal shall be installed within 450 mm (18") of the enclosure.

**AVERTISSEMENT:** - Ouvrir les circuits avant d'enlever le couvercle. Un scellement doit être installé à moins de 450 mm du boîtier.

### CAUTION!

Allow a minimum of 10 minutes before opening the GEN2000® for internal inspection. This allows time for the gauge to de-energize, cool, and fully discharge the capacitor.

Two circuit boards in the LFXG-D are field replaceable.

Figure 19 and Figure 20 identify these two circuit boards.

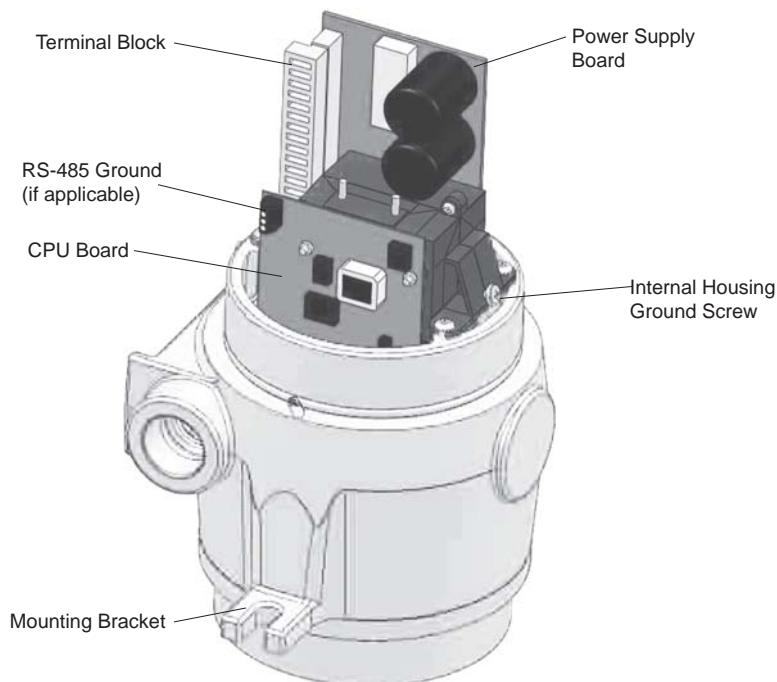


Figure 19: Circuit board identifications

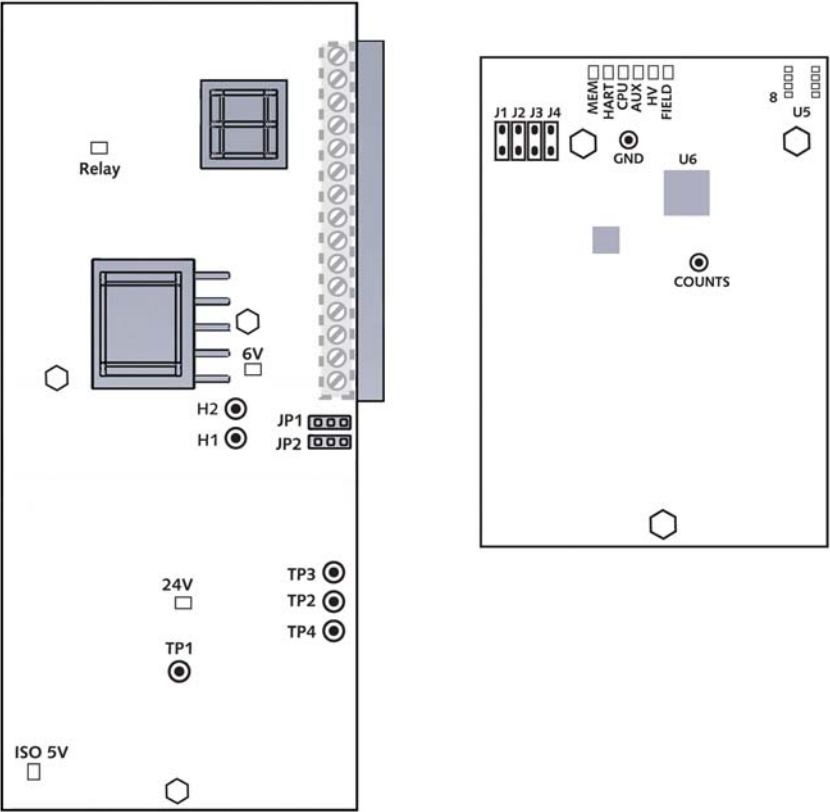


Figure 20: Power supply board simplified component layout

**Note:** Jumper positions for JP1, JP2, and JP3 are set to NORM.

## Test points

Table 9: Power supply board test point labels and descriptions

### Power supply board

Label	Description
+3V	Voltage generated on the FDIP board
+6.4V	Voltage generated on the FDIP board
FBRX	Non-Isolated FB Rx signal (Factory Diagnostics)
FBTX	Non-Isolated FB Tx signal (Factory Diagnostics)
FBGND	Isolated FB ground
FB -	FB (-) signal, same as P1-14
FB +	FB (+) signal, same as P1-13
+5VDC	Gauge generated logic supply
DGND	Ground for +5V logic

Table 10: CPU board test point labels and descriptions

Label	Description
Count	Raw input signal coming from the preamplifier
GND	Logic ground
U5 pin 8	+5V power supply test point, referenced to logic ground

## Jumpers

The LFXG-D does not use jumpers J1-J4 on the CPU board.

## Power supply board LED indicators

Table 11: Power supply board LED descriptions, conditions, and recommendations

LED	Description	Normal Condition	Error Condition	Recommendation
+24V	Intermediate voltage level (Factory Diagnostics only)	ON	OFF	Call VEGA Field Service.
Relay	Relay condition indicator	ON—relay is energized. OFF—relay is de-energized	None	Check against relay output terminals 3, 4, and 5. If no relay output, replace power supply board.



## CPU board LED indicators

Use the LED indicators on the CPU board to check the basic functioning of the level gauge. They are visible when you remove the explosion-proof housing pipe cap.

### FLASH corrupt LED pattern

The FLASH chip stores the gauge firmware. The transmitter does not operate if the FLASH chip is corrupt. A fieldbus device that connects to the transmitter displays the message, No Device Found. In this situation, the LED bank displays a distinctive pattern shown in Figure 21.

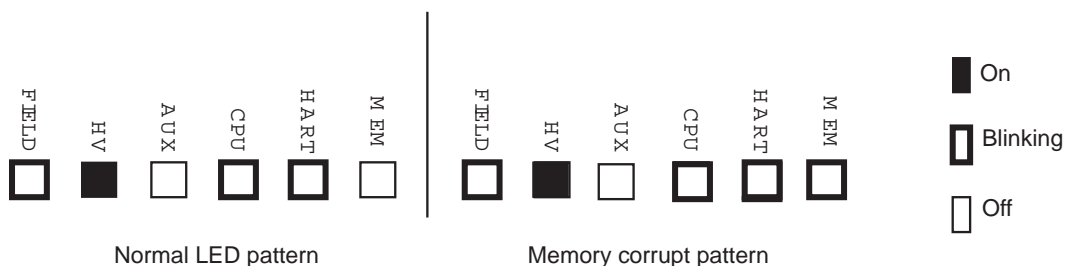


Figure 21: CPU LED indicators

**Note:** If the LED band displays the Memory Corrupt pattern, call VEGA Field Service to report this condition. The gauge does not operate if the FLASH chip is corrupt.

## CPU board LED summary table

Table 12: CPU board LED summary

LED	Description	Normal Condition	Error Condition	Recommendation
Mem	Memory corruption	OFF	<u>Blink Pattern</u> 1—CPU EEPROM corrupt 2—Sensor EEPROM corrupt 3—Both EEPROMs corrupt 4—RAM corrupt 5—Flash memory corrupt ON solid—Combination of errors	Check software diagnostics. Call VEGA Field service.
HAR T	Fieldbus communication indicator	OFF—blinks when receiving Fieldbus messages	None	Check Fieldbus device connection on loop and Fieldbus device
CPU	Central processing unit	Blinks at rate of once per second	LED does not blink. CPU not functioning	Check power input. Replace CPU board.
Aux	Auxiliary input frequency signal indicator	Blinks if auxiliary input is present. Off if no auxiliary input is present	None	Check auxiliary input wiring terminals 11 and 12 with a meter for frequency signal. Check auxiliary input equipment.
HV	Sensor high voltage	On—high voltage is within specification	Off—high voltage is outside of specification	Call VEGA Field Service.
Field	Radiation field indicator	Cycles in proportion to radiation field intensity at detector. On for 10 seconds for each mR/hr, then off for 2 seconds. (Use LED 5, which blinks 1 time/second to time LED1 for field indicator.)	None	Check for closed source shutter, buildup, and/or insulation.

## Troubleshooting

The following tables and flow charts may be useful to determine the source of a problem. They cover these topics:

- Fieldbus communication problems
- LFXG-D transmitter not responding

Hardware troubleshooting is available at the board, not the component level. Essentially, only the following two hardware components are field-replaceable:

- CPU board
- Power supply board

## Fieldbus physical layer setup / diagnostics

Perform the following steps to establish or troubleshoot Foundation Fieldbus communications with an VEGA nuclear gauge.

To establish or troubleshoot communications

- Review the wiring to any devices on the Fieldbus segment. VEGA recommends the use of 18-gauge shielded cable (total cable, including spurs, not to exceed 1900 meters). Make sure there are exactly two terminators on the fieldbus segment. One terminator should be at the control room junction box and the other terminator should be at the farthest field junction box.
- Verify that the shield is continuous over the entire length of the cable is tied to the earth ground at only one point.
- Check the voltage across power supply connector P1, terminals 13 and 14, at each gauge. To meet Fieldbus specifications, the voltage must be between 9 and 32 volts at each gauge on the segment.
- If a Relcom FBT-3 Fieldbus monitor is available, connect it to the Fieldbus segment at the gauge. It detects Fieldbus activity and reports the number of Fieldbus units seen on the segment.
- If the FBT-3 monitor is unable to detect Fieldbus communication activity, there is a wiring problem within the Fieldbus segment. Use the FBT-3 monitor to work backwards through the wiring, towards the control room, until Fieldbus activity is detected. Correct the wiring in that area.

- If the host DCS system is able to detect the Fieldbus gauge but is unable to get measurement data from the gauge, check the HART LED on the gauge CPU board. The HART LED normally is in the OFF state. It flashes briefly when the Fieldbus interface board (FDIP) tries to communicate with the gauge CPU. If this LED does not flash, replace the CPU board.

## Summary of fieldbus troubleshooting

Table 13: Fieldbus troubleshooting

Problems	Possible Causes	Recommended Actions
Block is not going into automode (stays in OOS).	The resource block is in OOS mode.	Set the target mode of the resource block to <b>AUTO</b> .
Resource block is out of service.	Improper setup	If the resource block is out of service, nothing else can be in service.
Block alarm active parameters	Invalid feature selection.	The A/O block units do not match the transducer block units.
Using external compensation		A/O block must be in cascade mode
If using external compensation and the compensation value does not update properly		Verify that the SP High Lim and SP Low Lim are set to the PV Scale range.
You receive frequent communication errors when you try to read or write to a device.	The device is in an invalid state.	Reset the device.
A device does not transmit alarms.	You have not configured the alarms.	For instructions on how to configure alarms, refer to the user manual for information on configuring alarms.
You are unable to write to a block parameter.	The parameter is read-only. The blocks are in an incorrect mode. The data is out of range.	If the parameter is not read-only, refer to the user manual that came with your host system.
A device does not appear in the Project window.	The communication parameters are incorrect.	Refer to the user manual that came with your host system.
You receive a status of <b>Bad:Device Failure</b> .	An error exists with the hardware.	Set the <b>RESTART</b> parameter in the Block window to <b>Processor</b> or <b>Default</b> . If the problem persists, replace the device.
A function block alternates between IMAN and AUTO modes. The status of the input parameter is <b>Bad:No comm</b> .	The function block and communication schedules do not have enough time between them.	Refer to the user manual that came with your host system.
The AI does not transition to AUTO mode from OOS mode.	The configuration is incorrect or incomplete.	Refer to the user manual that came with your host system.

## Maintenance and repair

### Periodic maintenance schedule



Since the VEGA level transmitter contains no moving parts, very little periodic maintenance is required. We suggest the following schedule to prevent problems and to comply with radiation regulations:

*Table 14: Periodic maintenance schedule*

Description	Frequency	Procedure
Standardize	As required by process conditions	Calibration chapter
Source holder shutter check	Every six months unless otherwise required by applicable nuclear regulatory agency	Radiation safety instructions shipped separately with source holder and following instructions
Source wipe	Every three years unless otherwise required by applicable nuclear regulatory agency	Radiation safety instructions shipped separately with source holder and following instructions

### Source wipe and shutter check recording

The VEGA level transmitter can automatically remind users when a source wipe and shutter check are due, using the diagnostic alarms. If you use this feature, you must record the source wipes and shutter checks in the software to acknowledge the alarm and to reset the timer.

Perform the following procedure after a source wipe or a shutter check. Refer to the Radiation Safety Manual and CD that came with your source holder (O/V part numbers 239291 and 244316).

Always refer to the safety instructions in this guide and the country specific installation standards. Follow the prevailing safety regulations and accident prevention rules of your company and country.

### Recording a source wipe

*Procedure 35: To record a source wipe*

1. From **Diagnostics TB 569**, select **RECORD\_WIPE\_NOW**
2. Click the value field  
The following selection displays:
  - **idle**
  - **execute**
3. Select **execute**.

### Recording a shutter check

*Procedure 36: To record a shutter check*

1. From **Diagnostics TB 569**, select **RECORD\_SHUTTER\_CHECK\_NOW**
2. Click the value field  
The following selection displays:
  - **idle**
  - **execute**
3. Select **execute**.

### Viewing the due date for source wipes and shutter checks

*Procedure 37: To view due date of source wipe*

From **Diagnostics TB 569**, select **DAYS\_TILL\_WIPE**.

The parameter values displays when the next source wipe or leak test is due.

*Procedure 38: To view due date of shutter check*

From **Diagnostics TB 569**, select **DAYS\_TILL\_SHUTTER\_CHK**.

The parameter value displays when the next source holder shutter check is due.

## Spare parts

Contact VEGA Field Service at +1 513-272-0131 for parts, service, and repairs.

Outside the U.S., contact your local VEGA representative for parts, service, and repairs.

## Field repair procedures

Very few parts are field repairable, but you can replace entire assemblies or boards. The following parts are replaceable:

- CPU circuit board
- Power supply circuit board



### Caution!

Use great care to prevent damage to the electrical components of the gauge. VEGA recommends appropriate electrostatic discharge procedures.

## Replacing the CPU or Power supply board

You may have to replace a circuit board if there is damage to one of its components.

Before replacing a circuit board, check the troubleshooting section or call VEGA Field Service to be sure a replacement is necessary.

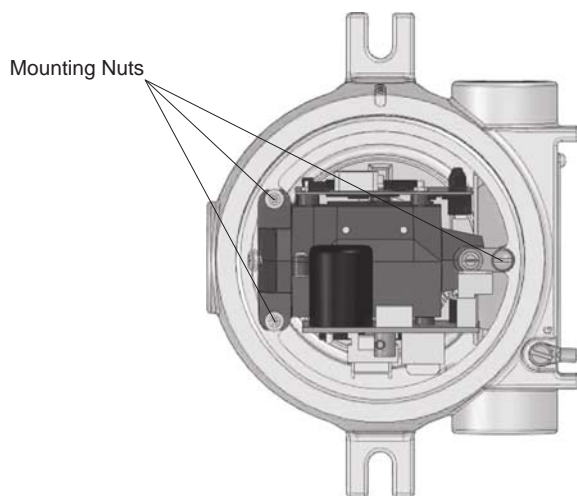
The sensor EEPROM contains a backup of the CPU board EEPROM. After physically replacing the CPU board, you must perform a memory backup to update the CPU board EEPROM with the information in the sensor board EEPROM. Perform the memory backup in the **New hardware** feature, from the **Advanced Functions** menu. Refer to page 80 for information on the **Advance Functions|New Hardware** feature.

## Replace the CPU or power supply board

*Procedure 39: To replace the CPU or power supply board*

1. Turn off power to the gauge.
2. Remove the housing cover.
3. Remove the plastic electronics cover.
4. Remove the terminal wiring connector.
5. Remove the three (3) screws holding the electronics package in place.
6. Carefully pull the electronics package out of the housing.
7. Remove the appropriate board from the clamshell assembly by removing the three (3) mounting nuts.  
  
**Note:** If you are changing the CPU board, you must move the old firmware chip to the new board if the new board firmware is different.
8. Carefully reconnect any ribbon cables.
9. Install the electronics package in the housing.
10. Replace the three (3) mounting nuts.
11. Reconnect the terminal wiring connector.
12. Install the plastic electronics cover.
13. Install the housing cover.
14. Turn on the power to the unit.
15. Connect a HART communicator to the unit and verify that the unit is operational.

**Note:** If you change the CPU board, a **New Hardware Found** error message normally appears when you connect with the HART communicator. In Ohmvie2000, click **Diagnostics**, **New hardware**, **New CPU**, and click **OK** for a new backup of EEPROMS.





## Requesting field service

To request field service within the U.S. and Canada; call 513-272-0131 from 8:00 A.M. to 5:00 P.M. Monday through Friday. For emergency service after hours, call 513-272-0131 and follow the voice mail instructions.

## Returning equipment for repair to VEGA

When calling VEGA to arrange repair service, have the following information available:

- ☒ Product model that is being returned for repair
- ☒ Description of the problem
- ☒ VEGA Customer Order (C.O.) Number
- ☒ Purchase order number for the repair service
- ☒ Shipping address
- ☒ Billing address
- ☒ Date needed
- ☒ Method of shipment
- ☒ Tax information

Notes

# Appendix I: Special applications

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This chapter provides application specific information for special installations.

If your application is not in this chapter, you may find application specific information on the certified drawings. The certified drawings are supplied by VEGA. If you have other application questions, contact VEGA Field Service in the U.S. or Canada at 513-272-0131 or your local representative outside of the U.S. or Canada.

## Internal heater kit for applications requiring a rating of $-50\text{ }^{\circ}\text{C}$

A heater kit option is available for the LFXG-D for applications that require a  $-50\text{ }^{\circ}\text{C}$  ( $-58\text{ }^{\circ}\text{F}$ ) temperature rating. With the heater option, the internal temperature of the unit rises approximately  $20\text{ }^{\circ}\text{C}$  ( $68\text{ }^{\circ}\text{F}$ ) degrees.

The features of the heater are as follows:

- The heater kit does not affect the functionality of the LFXG-D in any way. There is no requirement for special firmware
- The factory installs the internal heater kit if you order it with the LFXG-D
- Three different kits are available: one for 115VAC, one for 220VAC, and one for 24VDC. The part numbers are shown below:

*Table 15: Heater kit part numbers*

Heater kit power	O/V Part Number
115VAC	240723
220VAC	240724
24VDC	241912

## Changes to specifications

The power rating changes from the specifications on page 5 of this manual when you install the heater kit on the LFXG-D.

With the installation of the heater, the maximum power consumption increases to 25W.

The unit is either 115VAC $\pm$ 10% or 220VAC $\pm$ 10% instead of the standard 90–270VAC range or 24VDC.

Notes

# Appendix II: Glossary

---

Tables 17 and 18 list the terms, meanings, and values for the LFXG-D and fieldbus system.

*Table 16: Measurements and values*

Term	Meaning	Value
m-	Milli-	$10^{-3}$
c-	Centi-	$10^{-2}$
k-	Kilo-	$10^3$
M-	Mega-	$10^6$

*Table 17: Terms and meanings*

Term	Meaning
A	Amperes
AI	Analog input. A type of function block
Alarm	A notification the communications manager software sends when it detects that a block leaves or returns to a particular state
Alarm conditions	A notification that a fieldbus device sends to another fieldbus device or interface when it leaves or returns to a particular state
Alert	An alarm or an event
Alert function	A function that receives or acknowledges an alert
Alert objects	Objects used for reporting of alarms and events
Analog network	A network that carries signals in analog form as a continuously varying range of electrical voltage or current
AO	Analog output
ASCII	American Standard Code for Information Interchange

*continued on next page*

Table 18: Terms and meanings (continued)

Term	Meaning
Bias device	A device that can communicate on the fieldbus, but cannot become the LAS
BG	Basic gain
Block	A logical software unit that makes up one named copy of a block and the associated parameters its block type specifies. The values of the parameters persist from one invocation of the block to the next. It can be a resource block, transducer block, or function block residing within a VFD
Block tag	A character string name that uniquely identifies a block on a fieldbus network
Block view objects	Variable list objects used to read multiple block parameters at once
Bridge	An interface in a fieldbus network between two different protocols
C	Celsius
Communication stack	The hierarchy of layers in a layered communications model that performs the services required to interface the user application to the physical layer of the fieldbus
Control loop	A set of connections between blocks used to perform a control algorithm
CPU	Central processing unit
DCS	Distributed control system
DD	Device description. A machine readable description of all the blocks and block parameters of a device
Device ID	An identifier for a device that the manufacturer assigns. Device IDs must be unique to the device; no two devices can have the same device ID

*continued on next page*

Table 18: Terms and meanings (continued)

Term	Meaning
Device tag	A name you assign to a fieldbus device
DI	Discrete input
Distributed control	Process control distributed among several devices connected by a network
DO	Discrete output
DRAM	Dynamic random access memory
Driver	Device driver software installed within the operation system
Dynamic link library	A library of functions and subroutines that links to an application at run time
EMI	Electromagnetic interference
Ethernet	A recognized standard local area network that uses coaxial cable
Event	An occurrence on a device that causes a fieldbus entity to send the fieldbus event message
F	Fahrenheit
FBAP	A fieldbus application that you create using FOUNDATION Fieldbus function blocks
Fieldbus	An all-digital, two-way communication system that connects control systems to instrumentation
Fieldbus Foundation	The organization that developed a fieldbus network specifically based upon the work and principles of the ISA/IEC standards committees
Fieldbus network address	Location of a board or device on the fieldbus; the fieldbus node address
FIP	Factory Instrumentation Protocol

*continued on next page*

Table 18: Terms and meanings (continued)

Term	Meaning
FOUNDATION Fieldbus	The communications network specification created by the Fieldbus Foundation
FF	FOUNDATION Fieldbus
Function block	A named block consisting of one or more input, output, and contained parameters. The block performs some control function as its algorithm. Function blocks are the core components you control a system with. The Fieldbus Foundation defines standard sets of function blocks. There are ten function blocks for the most basic control and I/O functions
Function block application	A fieldbus application that you create using FOUNDATION fieldbus function blocks
IEC	International Electrotechnical Commission. A technical standards committee that is at the same level as the ISO
in.	Inches
Input parameter	A block parameter that received data from another block
I/O	Input/output
IRQ	Interrupt request
ISO	International Organization for Standardization. A technical standards organization that creates international technical standards for computers and communications. The ISO is composed of national standards organizations in 89 countries. The American National Standards Institute (ANSI) represents the United States in the ISO.
LAN	Local area network. A communications network that is limited in physical spatial area for the purpose of easier connection of computers in neighboring buildings.

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Table 18: Terms and meanings (continued)

Term	Meaning
LAS	Link active scheduler. A device that is responsible for keeping a link operational. The LAS executes the link schedule, circulates tokens, distributes time, and probes for new devices.
Link	A group of fieldbus devices that connect across a single wire pair with no intervening bridges
Link active schedule	A schedule of times in the macrocycle when devices must publish their output values on the fieldbus
Link identifier	A number that specifies a link
Link master device	A device that is capable of becoming the LAS. A link master device controls the communications traffic on a link. It prevents multiple devices from communicating data at the same time.
Linkage	A connection between function blocks
Link object	An object resident in a device that defines connections between function block input and output across the network. Link objects also specify trending connections.
Loop	A set of connections between blocks used to perform a control algorithm
m	meters
Macrocycle	The least common multiple of all the loop times on a given link
Network management	A layer of the FOUNDATION Fieldbus communication stack that contains objects that other layers of the communication stack use, such as Data Link, FAS, and FMS. You can read and write SM and NM objects over the fieldbus using FMS Read and FMS Write services.
Non-scheduled/acyclic communication	Communication that occurs at times that are not predetermined
Non-volatile memory	Memory that does not require electricity to hold data

*continued on next page*

Table 18: Terms and meanings (continued)

Term	Meaning
OOS	Out of service
Operator acknowledgment alarm	The verification an operator performs when receiving a fieldbus message
Output parameter	A block parameter that sends data to another block
Parameter	One of a set of network-visible values that makes up a function block
PC	Personal computer
Physical device	A single device residing at a unique address on the fieldbus
Physical device tag	A user-defined name for a physical device
PLC	Programmable logic control. A device with multiple inputs and outputs that contain a program you can alter
Poll	To repeatedly inspect a variable or function block to acquire data
Process variable	A common fieldbus function block parameter representing some value in the process being controlled
RC	Ratio control
Resource block	A block that describes general characteristics of a device, such as manufacturer and device name. Allows only one resource block per device.
s	Seconds
Sample type	Specifies how trends are sampled on a device, whether by averaging data or by instantaneous sampling
Stale	Data that has not been updated for stale_limit number of macrocycles, where the stale limit is a parameter of the connection
Tag	A name you can define for a block, VFD, or device
TB	Transducer Block

# Appendix III: Parameters

---

This section lists the transducer and AI block parameters, descriptions, and modes that are important for the set up and calibration of the LFXG-D. The minimum parameters that must be set for level measurement are:

- Transducer Blocks
  - DEVICE\_SELECT (set to Level) in Process TB 449
  - FILTER\_TYPE in Setup TB 508
  - FAST\_CUTOFF in Setup TB 508
  - DATA\_COLLECT\_INTERVAL in Setup TB 508
  - PRIMARY\_VALUE\_RANGE in both Process TB 449 and Setup 508
  - LINEARIZER\_TYPE in Setup TB 508
  - LINEARIZER\_VALUE (optional—only if using the table-non-linear type) in Diagnostics TB 569
  - LINEARIZER COUNTS (optional—only if using the table-non-linear type) in Diagnostics TB 569
- AI block
  - XD\_SCALE
  - OUT\_SCALE
  - CHANNEL (set to primary channel)
- AO block (for external source auxiliary input)
  - MODE\_BLOCK
  - XD\_SCALE
  - OUT\_SCALE
  - CHANNEL (set to primary channel)

Table 18: Transducer block parameters

Parameter	Description	Mode (R/W)
BLOCK_ALM In Process, Setup, and Diagnostics TBs	The block alarm is used for all configuration, hardware, connection failure, or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.	
	<b>Sub-parameter</b>	<b>Description</b>
	UNACKNOWLEDGED	A discrete enumeration that is set to Unacknowledged when an update occurs, and set to Acknowledged by a write from an interface device that can confirm that the alarm has been noticed.
	ALARM_STATE	A discrete enumeration that gives an indication of whether the alert is active and whether it has been reported.
	TIME_STAMP	The time when evaluation of the block was started and a change in alarm/event state was detected that is unreported. The time stamp value will be maintained constant until alert confirmation has been received – even if another change of state occurs.
	SUB_CODE	An enumeration specifying the cause of the alert to be reported.
	VALUE	The value of the associated parameter at the time the alert was detected.
XD_ERROR In Process, Setup, and Diagnostics TBs	One of the transducer error codes. Block Alarm Sub-codes.	R
TRANSDUCER_STATE In Process, Setup, and Diagnostics TBs	Deactivates or disables the cyclic commands of the transducer.	W
DEVICE_ERR In Process, Setup, and Diagnostics TBs	Gauge specific errors that have occurred.	R
BLOCK_ALM_ACTIVE In Process, Setup, and Diagnostics TBs	Block configuration alarms.	R

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Table 19: Transducer block parameters (continued)

Parameter	Description		Mode (R/W)
PRIMARY_VALUE In Process and Diagnostics TBs	The measured value and status available to the Function Block.		
	Sub-parameter	Description	Mode (R/W)
	VALUE	A numerical quantity entered by a user or calculated by an algorithm.	W
	STATUS	Digital transducers, unlike their analog versions, can detect faults that make the measurement bad or prevent the actuator from responding. This additional, valuable information will be passed along with each transmission of a data value in the form of a status attribute. Choices are made in the QUALITY, SUBSTATUS, and Limits sub-parameters.	
	QUALITY	Choices are: <ul style="list-style-type: none"> <li>• Bad</li> <li>• Uncertain</li> <li>• Good_Noncascade</li> <li>• Good_Cascade</li> </ul>	W
	SUBSTATUS	Choices are: <ul style="list-style-type: none"> <li>• NonSpecific</li> <li>• LastUsableValue</li> <li>• SubstituteValue</li> <li>• InitialValue</li> <li>• SensorConversionNotAccurate</li> <li>• EngUnitRangeViolation</li> <li>• Subnormal</li> </ul>	W
	LIMITS	Choices are: <ul style="list-style-type: none"> <li>• NotLimited</li> <li>• LowLimited</li> <li>• HighLimited</li> <li>• Constant</li> </ul>	W
PRIMARY_VALUE_RANGE In Process and Diagnostics TBs	The High and Low range limit values, the engineering units code and the number of digits to the right of the decimal point to be used to display the Primary Value.		
	Sub-parameter	Description	Mode (R/W)
	EU_100	The engineering unit value that represents the upper end of range of the associated block parameter.	W
	EU_0	The engineering unit value that represents the lower end of range of the associated block parameter.	W
	UNITS_INDEX	Device Description (DD) units code index for the engineering unit descriptor for the associated block value. <b>The units in this range must match the units in the Analog Input (AO) block.</b> Choices are: <ul style="list-style-type: none"> <li>• Counts per Second</li> <li>• Unitless</li> <li>• in</li> <li>• ft</li> <li>• cm</li> <li>• mm</li> <li>• M</li> <li>• %</li> </ul>	W
	DECIMAL	The number of digits to the right of the decimal point that should be used by an interface device in displaying the specified parameter.	W

continued on next page

Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
DEVICE_SELECT In Process TB	Select the operational mode of the gauge. The gauge must be power cycled (including the fieldbus connection) after this change is made. Choices are: <ul style="list-style-type: none"> <li>• Undefined</li> <li>• Level</li> <li>• Density</li> </ul>	W
COMPENSATION_SELECT In Process TB	Select the type of level compensation required (as necessary). Choices are: <ul style="list-style-type: none"> <li>• undefined</li> <li>• None</li> <li>• NORM compensation Lvl</li> <li>• Vapor compensation Lvl</li> <li>• Summation</li> </ul>	W
COMPENSATION_SOURCE In Process TB	Specify the source of the compensation value when a compensation mode is enabled. This value can be internal (calculated from the aux input) or external (using COMPENSATION_VALUE). Choices are: <ul style="list-style-type: none"> <li>• undefined</li> <li>• none</li> <li>• internal</li> <li>• external</li> </ul>	W
COMPENSATION_VALUE In Process TB	This value is only valid if the COMPENSATION_SOURCE is set to external. If so, this variable is the value from the external device.	
	<b>Sub-parameter</b>	<b>Description</b>
	VALUE	Displays the compensation value.
	STATUS	Displays the status of this value.
	QUALITY	Displays the quality.
	SUBSTATUS	Displays the sub-status.
	LIMITS	Displays the limits if any.

continued on next page

Table 19: Transducer block parameters (continued)

Parameter	Description		Mode (R/W)
SECONDARY_VALUE In Process TB	The secondary value related to the sensor.		
	Sub-parameter	Description	Mode (R/W)
	VALUE	A numerical quantity entered by a user or calculated by an algorithm.	W
	STATUS	Digital transducers, unlike their analog versions, can detect faults that make the measurement bad or prevent the actuator from responding. This additional, valuable information will be passed along with each transmission of a data value in the form of a status attribute. Choices are made in the QUALITY, SUBSTATUS, and Limits sub-parameters.	W
	QUALITY	Choices are: <ul style="list-style-type: none"> <li>• Bad</li> <li>• Uncertain</li> <li>• Good_Noncascade</li> <li>• Good_Cascade</li> </ul>	W
	SUBSTATUS	Choices are: <ul style="list-style-type: none"> <li>• NonSpecific</li> <li>• LastUsableValue</li> <li>• SubstituteValue</li> <li>• InitialValue</li> <li>• SensorConversionNotAccurate</li> <li>• EngUnitRangeViolation</li> <li>• Subnormal</li> </ul>	W
	LIMITS	Choices are: <ul style="list-style-type: none"> <li>• NotLimited</li> <li>• LowLimited</li> <li>• HighLimited</li> <li>• Constant</li> </ul>	W
SECONDARY_VALUE_RANGE In Process TB	Specify the span and units for the auxiliary input channel.		
	Sub-parameter	Description	Mode (R/W)
	EU_100	The engineering unit value that represents the upper end of range of the associated block parameter.	W
	EU_0	The engineering unit value that represents the lower end of range of the associated block parameter.	W
	UNITS_INDEX	Device Description (DD) units code index for the engineering unit descriptor for the associated block value. <b>This unit must match the AO block units.</b> Choices are: <ul style="list-style-type: none"> <li>• Counts per Second</li> <li>• Unitless</li> </ul>	W
	DECIMAL	The number of digits to the right of the decimal point that should be used by an interface device in displaying the specified parameter.	W

*continued on next page*

Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
SECONDARY_STATUS In Process TB	Indicates the status of the auxiliary input. The input is either ON (when a compensation mode is enabled) or OFF.	W
SECONDARY_DATA_COLLECT In Process TB	Perform a data collect for the auxiliary input channel. Show the averaged counts when done. Choices are: <ul style="list-style-type: none"> <li>no collection</li> <li>execute</li> </ul>	W
SECONDARY_WRITE_CAL In Process TB	Write the auxiliary input channel calibration values. This is done after the SECONDARY_LO_CAL_COUNTS and SECONDARY_HI_CAL_COUNTS values are written. Choices are: <ul style="list-style-type: none"> <li>no secondary write calibration help</li> <li>execute</li> </ul>	W
RELAY_VALUE In Process TB	Indicates the status of the relay. If 0, the relay is de-energized. If 1, the relay is energized.	
	<b>Sub-parameter</b>	<b>Description</b>
	VALUE	Displays the relay value.
	STATUS	Displays the status of the value.
	QUALITY	Displays the quality of the information.
	SUBSTATUS	Displays the sub-status of the information.
	LIMITS	Displays the limits if any.
RELAY_STATUS_TEST In Process TB	Enable or disable relay test mode. Choices are: <ul style="list-style-type: none"> <li>0=disable</li> <li>1=relay on</li> <li>2=relay off</li> </ul>	W
RELAY_ALARM_MASK In Process TB	Specifies which alarms the relay <b>does not</b> respond to. Choices are: <ul style="list-style-type: none"> <li>RAM Corrupt</li> <li>Sensor EEPROM corrupt</li> <li>FLASH corrupt</li> <li>Real time clock fail</li> <li>Internal Temperature sensor failure</li> <li>STDZ due</li> <li>Source wipe due</li> <li>X-ray detected</li> <li>CPU EEPROM corrupt</li> <li>Not Used</li> <li>Not Used</li> <li>Shutter check due</li> <li>New hardware/new CPU</li> <li>Reserved</li> <li>Reserved</li> <li>Calibration error</li> <li>Sensor fail</li> <li>Process out of measurement range</li> <li>Sensor high voltage fail</li> </ul>	W

*continued on next page*



Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
LINEARIZER_TYPE In Setup TB	Specifies the type of linearizer used for the PV calculation. This can be a linear table, or a non-linear table (calculated from the linearizer data points). Choices are: <ul style="list-style-type: none"> <li>• table-nonlinear</li> <li>• table-linear</li> </ul>	W
RESERVED_1 In Setup TB	Reserved for density applications	R
SOURCE_TYPE In Setup TB	Specifies the type of radiation source being used. This setting determines the type of source decay to use. Choices are: <ul style="list-style-type: none"> <li>• Cs 137</li> <li>• Co 60</li> <li>• AM 241</li> <li>• Cf 252</li> <li>• No Source</li> </ul>	W
PRIMARY_FILTER_VALUE In Setup TB	Filter time constant applied to the final PV output.	W
FILTER_TYPE In Setup TB	Specifies the type of filter used on the PV output and auxiliary input. Can be an RC (analog) filter or rectangular window (digital) filter. Choices are: <ul style="list-style-type: none"> <li>• rc filter</li> <li>• digital</li> </ul>	W
FAST_CUTOFF In Setup TB	Fast response cutoff is change in successive process value samples at which filtering is bypassed. Enables response to large process step changes.	W
RESERVED_2 In Setup TB	Reserved for density applications.	R
X-RAY THRESHOLD In Setup TB	The set percentage beyond Counts Low that will trigger X-ray suppression.	W
LINEAR_UNITS In Setup TB	Select the units to be used for the vessel ID value. Choices are: <ul style="list-style-type: none"> <li>• in</li> <li>• ft</li> <li>• cm</li> <li>• mm</li> <li>• m</li> </ul>	W
RESERVED_3 In Setup TB	Reserved for density applications.	R
TRANSFER_FUNCTION In Setup TB	Reserved.	R
LAST_RESET In Diagnostics TB	Date of the last time the gauge was reset or power cycled.	R
VESSEL_ID In Setup TB	Inner diameter of vessel in units set in LINEAR_UNITS used for the empirical linearizer calculation.	W
SENSOR_LOCATION In Setup TB	Select either a remote or local sensor.	W
SENSOR_SERIAL_NUMBER In Diagnostics TB	Sensor serial number for this gauge. Maximum length=8.	R
CPU_SERIAL_NUMBER In Diagnostics TB	CPU's serial number for this gauge. Maximum length=8.	R
ASSEMBLY_NUMBER In Diagnostics TB	Reserved.	W

*continued on next page*

Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
LINEARIZER_VALUE In Diagnostics TB	PV values for the linearizer data points (up to 11 points)	
	<b>Sub-parameter</b>	<b>Description</b>
	LINEARIZER_VALUE	Point zero PV value
	LINEARIZER_VALUE	Point one PV value.
	LINEARIZER_VALUE	Point two PV value.
	LINEARIZER_VALUE	Point three PV value.
	LINEARIZER_VALUE	Point four PV value
	LINEARIZER_VALUE	Point five PV value.
	LINEARIZER_VALUE	Point six PV value
	LINEARIZER_VALUE	Point seven PV value
	LINEARIZER_VALUE	Point eight PV value
	LINEARIZER_VALUE	Point nine PV value
	LINEARIZER_VALUE	Point ten PV value
LINEARIZER_COUNTS In Diagnostics TB	Count values for the linearizer data points (up to 11 points).	
	<b>Sub-parameter</b>	<b>Description</b>
	LINEARIZER_COUNTS	Point zero count value
	LINEARIZER_COUNTS	Point one count value
	LINEARIZER_COUNTS	Point two count value
	LINEARIZER_COUNTS	Point three count value
	LINEARIZER_COUNTS	Point four count value
	LINEARIZER_COUNTS	Point five count value
	LINEARIZER_COUNTS	Point six count value
	LINEARIZER_COUNTS	Point seven count value
	LINEARIZER_COUNTS	Point eight count value
	LINEARIZER_COUNTS	Point nine count value
	LINEARIZER_COUNTS	Point ten count value
LINEARIZER_NUM_POINTS In Diagnostics TB	Specifies the number of linearizer data points currently defined for calculating a new linearizer curve.	W
LINEARIZER_SAVE_DATA In Diagnostics TB	Choices are: <ul style="list-style-type: none"> <li>• Idle</li> <li>• Save Current Values</li> <li>• Reset to Saved Values</li> </ul>	W
LINEARIZER_STATE In Diagnostics TB	Choices are: <ul style="list-style-type: none"> <li>• Unknown State</li> <li>• Current Values Saved</li> <li>• Current Values Not Saved</li> </ul>	W

*continued on next page*

Table 19: Transducer block parameters (continued)

Parameter	Description		Mode (R/W)
LINEARIZER_PERCENT_SPAN_1 In Diagnostics TB	First 25 values in the 41 point linearizer table. These values represent the percent of process span for a corresponding percent of count span value.		
	Sub-parameter	Description	Mode (R/W)
	LINEARIZER_PERCENT_SPAN_1	Value=0	W
	LINEARIZER_PERCENT_SPAN_1	Value=2.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=5	W
	LINEARIZER_PERCENT_SPAN_1	Value=7.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=10	W
	LINEARIZER_PERCENT_SPAN_1	Value=12.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=15	W
	LINEARIZER_PERCENT_SPAN_1	Value=17.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=20	W
	LINEARIZER_PERCENT_SPAN_1	Value=22.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=25	W
	LINEARIZER_PERCENT_SPAN_1	Value=27.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=30	W
	LINEARIZER_PERCENT_SPAN_1	Value=32.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=35	W
	LINEARIZER_PERCENT_SPAN_1	Value=37.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=40	W
	LINEARIZER_PERCENT_SPAN_1	Value=42.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=45	W
	LINEARIZER_PERCENT_SPAN_1	Value=47.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=50	W
	LINEARIZER_PERCENT_SPAN_1	Value=52.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=55	W
	LINEARIZER_PERCENT_SPAN_1	Value=57.5	W
	LINEARIZER_PERCENT_SPAN_1	Value=60	W
LINEARIZER_PERCENT_SPAN_2 In Diagnostics TB	Last 16 values in the 41 point linearizer table. These values represent the percent of process span for a corresponding percent of count span value.		
	Sub-parameter	Description	Mode (R/W)
	LINEARIZER_PERCENT_SPAN_2	Value=62.5	W
	LINEARIZER_PERCENT_SPAN_2	Value=65	W
	LINEARIZER_PERCENT_SPAN_2	Value=67.5	W
	LINEARIZER_PERCENT_SPAN_2	Value=70	W
	LINEARIZER_PERCENT_SPAN_2	Value=72.5	W
	LINEARIZER_PERCENT_SPAN_2	Value=75	W
	LINEARIZER_PERCENT_SPAN_2	Value=77.5	W
	LINEARIZER_PERCENT_SPAN_2	Value=80	W
	LINEARIZER_PERCENT_SPAN_2	Value=82.5	W
	LINEARIZER_PERCENT_SPAN_2	Value=85	W
	LINEARIZER_PERCENT_SPAN_2	Value=87.5	W
	LINEARIZER_PERCENT_SPAN_2	Value=90	W
	LINEARIZER_PERCENT_SPAN_2	Value=92.5	W
	LINEARIZER_PERCENT_SPAN_2	Value=95	W
	LINEARIZER_PERCENT_SPAN_2	Value=97.5	W
	LINEARIZER_PERCENT_SPAN_2	Value=100	W

continued on next page

Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
RESERVED	Reserved for a command.	R
CALCULATE_LINEARITY_NOW In Diagnostics TB	Using the linearizer data points (number of points specified by LINEARIZER_NUM_POINTS), calculate a new 41 point linearizer curve, LINEARIZER_PERCENT_SPAN values. Choices are: <ul style="list-style-type: none"> <li>not calculating linearity</li> <li>calculate linearity now</li> </ul>	W
AVERAGE_COUNTS In Process and Diagnostics TBs	Averaged counts for the sensor from a data collect operation.	R
DELETE_ALL_DATA_POINTS In Diagnostics TB	Delete all defined linearizer data points. The variable LINEARIZER_NUM_POINTS will be set to 0. Choices are: <ul style="list-style-type: none"> <li>Idle</li> <li>Delete all data points</li> </ul>	W
STANDARDIZE_VALUE_SOURCE In Setup TB	Displays whether Process STDZ uses lab entry of process value or Default Stdz value.	R
STANDARDIZE_TYPE In Setup TB	Configure whether Process STDZ uses lab entry of process value or Default Stdz value. Choices are: <ul style="list-style-type: none"> <li>Use Lab sample value</li> <li>Use Default value</li> </ul>	W
STANDARDIZE_DEFAULT_VALUE In Setup TB	The default standardization value in engineering units displayed during a standardize procedure. This default may be overridden during the procedure.	W
CALCULATE_CALIBRATION_NOW In Process TB	Recalculate new calibration parameters based on CAL_POINT_HI, CAL_POINT_HI_COUNTS, CAL_POINT_LO, and CAL_POINT_LO_COUNTS. Choices are: <ul style="list-style-type: none"> <li>no calibration calculation</li> <li>calculate calibration now</li> </ul>	W
DATA_COLLECT_INTERVAL In Setup TB	Data collection interval is the time in seconds over which the system averages the sensor counts.	W
WARNING_DELTA In Setup TB	Specifies the difference between the Cal low value and Cal high as a percent of span that will cause a warning to appear during a calibration.	W
CAL_POINT_LO_DATE In Process TB	Date when the CAL_POINT_LO_COUNTS were acquired. Enter as MM/DD/YY and HH:MM:SS.	W
CAL_POINT_LO In Process TB	The lowest calibrated value.	W
CAL_POINT_LO_COUNTS In Process TB	Averaged sensor counts for the calibration on low process.	W

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Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
CAL_POINT_HI_DATE In Process TB	Date when the CAL_POINT_HI_COUNTS were acquired. Enter as MM/DD/YY and HH:MM:SS.	W
CAL_POINT_HI In Process TB	The highest calibrated value.	W
CAL_POINT_HI_COUNTS In Process TB	Averaged sensor counts for the calibration on high process.	W
STANDARDIZE_DATE In Setup TB	Date of the last standardization.	R
STANDARDIZE_POINT In Setup TB	Process value recorded for the last standardization.	W
STANDARDIZE_COUNTS In Setup TB	Sensor counts recorded for the last standardization.	W
STANDARDIZE_SUCCESS In Setup TB	Indicates success or failure of the standardization.	R
PRIMARY_RAW_COUNTS In Process and Diagnostics TBs	Raw counts from the sensor.	
	<b>Sub-parameter</b>	<b>Description</b>
	VALUE	A numerical quantity entered by a user or calculated by an algorithm.
	STATUS	Digital transducers, unlike their analog versions, can detect faults that make the measurement bad or prevent the actuator from responding. This additional, valuable information will be passed along with each transmission of a data value in the form of a status attribute. Choices are made in the QUALITY, SUBSTATUS, and LIMITS sub-parameters.
	QUALITY	Choices are: <ul style="list-style-type: none"> <li>• Bad</li> <li>• Uncertain</li> <li>• Good_Noncascade</li> <li>• Good_Cascade</li> </ul>
	SUBSTATUS	Choices are: <ul style="list-style-type: none"> <li>• NonSpecific</li> <li>• LastUsableValue</li> <li>• SubstituteValue</li> <li>• InitialValue</li> <li>• SensorConversionNotAccurate</li> <li>• EngUnitRangeViolation</li> <li>• Subnormal</li> </ul>
	LIMITS	Choices are: <ul style="list-style-type: none"> <li>• NotLimited</li> <li>• LowLimited</li> <li>• HighLimited</li> <li>• Constant</li> </ul>
SECONDARY_RAW_COUNTS In Process and Diagnostics	Raw counts from the auxiliary input.	W
COUNTS_LOW In Process TB	Compensated sensor counts at low calibration point. Source and stdz gain applied.	R
COUNTS_HIGH In Process TB	Compensated sensor counts at high calibration point. Source and stdz gain applied.	R
COUNTS_RANGE In Process TB	Difference in low and high counts.	R

continued on next page

Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
SOURCE_DECAY_COUNTS In Process TB	Process chain counts after the SOURCE_DECAY_GAIN is applied to the sensor counts.	R
COUNT_RANGE_PERCENT In Process TB	Raw counts as a percent of count range (between COUNTS_LOW and COUNTS_HIGH).	R
SOURCE_DECAY_GAIN In Process TB	Current value of source decay gain. System resets to 1.0 at standardize or calibration. Increases exponentially each day (value is calculated on the midnight roll over.)	R
COMPENSATION_COUNTS In Process TB	Process chain counts after STDZ gain has been applied.	R
SUMMATION_COUNTS In Process TB	Process chain counts after auxiliary input counts have been added to the sensor counts. This only happens if COMPENSATION_SELECT is set to Summation.	R
UNFILTERED_VALUE In Process TB	Process variable – PV – Digital value that represents the level value in engineering units.	R
PROCESS_TEMP In Process TB	Temperature of the process material. This is only used for temperature compensated density measurements.	R
UNCOMPENSATED_VALUE In Process TB	Process variable – PV – Digital value that represents the level value before compensation is applied.	R
RECORD_WIPE_NOW In Diagnostics TB	Use this function to track source wipes or leak tests. System will remind you when next source wipe is due if diagnostic alarms are set. Choices are: <ul style="list-style-type: none"> <li>idle</li> <li>execute</li> </ul>	W
RECORD_SHUTTER_CHK_NOW In Diagnostics TB	Use this function to track shutter checks. System will remind you when the next shutter check is due if the diagnostic alarms are set. Choices are: <ul style="list-style-type: none"> <li>not recording shutter check</li> <li>execute</li> </ul>	W
DAYS_TILL_WIPE In Diagnostics TB	Displays when a source wipe or leak test is due. Refer to the manual, license, and local regulations. Alternatively, call VEGA at 513-272-0131.	R
DAYS_TILL_SHUTTER_CHK In Diagnostics TB	Displays when a source holder shutter check is due, to confirm the source holder shutter functioning. The source holder shutter is used to shield the radiation beam.	R
TIME_REMAINING In Process, Setup, and Diagnostics TBs	Time remaining for data collect in seconds.	R
UNIFORMITY_GAIN_COUNTS In Process TB	Process chain counts after the UNIFORMITY_GAIN has been applied.	R
WIPE_INTERVAL In Setup TB	Interval in days between successive Source Wipe Due messages. Set according to license, source, and applicable regulations.	W
SHUTTER_CHECK_INTERVAL In Setup TB	Interval in days between successive Shutter Check Due messages. Set interval according to license, source holder model, and application regulations.	W
SECONDARY_COUNTS In Diagnostics TB	Auxiliary input counts.	W
SECONDARY_LO_CAL_COUNTS In Diagnostics TB	Not used.	W
SECONDARY_HI_CAL_COUNTS In Diagnostics TB	Not used.	W

continued on next page

Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
SECONDARY_SET_LO_CAL In Diagnostics TB	Confirms that the auxiliary channel data collect counts are to be used for the auxiliary input low calibration. Write the value of AUX_COUNTS to SECONDARY_LO_CAL_COUNTS. Choices are: <ul style="list-style-type: none"> <li>idle</li> <li>set lo cal now</li> </ul>	W
SECONDARY_SET_HI_CAL In Diagnostics TB	Confirms that the auxiliary channel data collect counts are to be used for the auxiliary input high calibration. Write the value of AUX_COUNTS to SECONDARY_HI_CAL_COUNTS. Choices are: <ul style="list-style-type: none"> <li>idle</li> <li>set hi cal now</li> </ul>	W
SECONDARY_MULT_COEFF_A In Setup TB	Auxiliary compensation input parameter	W
SECONDARY_MULT_COEFF_B In Setup TB	Auxiliary compensation input parameter	W
SECONDARY_CUST_COEFF_A In Setup TB	Auxiliary compensation input parameter	W
SECONDARY_CUST_COEFF_B In Setup TB	Auxiliary compensation input parameter	W
SECONDARY_CUST_COEFF_C In Setup TB	Auxiliary compensation input parameter	W
<i>COPY_NV_MEMORY</i> In Diagnostics TB	Force the non-volatile memory in the gauge to be updated with the current configuration. This is used to resolve NEW HARDWARE FOUND errors or used when a new CPU or sensor is installed. Choices are: <ul style="list-style-type: none"> <li>idle</li> <li>CPU main→sensor backup</li> <li>sensor main→CPU backup</li> <li>main mems→backup mems</li> </ul>	W
PERFORM_SELF_TEST_NOW In Diagnostics TB	Reserved.	R
UNIFORMITY_GAIN In Diagnostics TB	A factory set multiplier adjustment for the sensor electronics.	R
HIGH_VOLTAGE_MONITOR In Diagnostics TB	Displays the sensor's measured high voltage.	R
TEMP_COMP_VALUE In Process TB	Process chain counts after the temperature compensation gain is applied.	R
TEMP_COMP_GAIN In Process TB	Gain term applied to the raw sensor counts.	R
FIRMWARE_VERSION In Diagnostics TB	Revision of the gauge's firmware.	R
HARDWARE_VERSION In Diagnostics TB	Revision of the gauge's hardware.	R
HIGH_VOLTAGE_SETTING In Process TB	Factory setting for the sensor high voltage.	R
STANDARD_COUNTS In Process TB	Sensor counts at last standardize.	R
SPAN_LIMIT In Setup TB	Not used.	R
BASE_VALUE In Setup TB	Process variable – PV – Digital value that represents the density or level value in engineering units.	R

continued on next page

Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
AVERAGE_AUX_COUNTS In Setup TB	Average counts from auxiliary channel data collect.	R
SECONDARY_FILTER_VALUE In Setup TB	Filter time constant applied to the auxiliary input channel counts.	W
STANDARDIZE_GAIN In Process TB	Displays current value of standardize gain. Reset to (Counts Low/Std Counts) at last standardize. Indicates percent change from calibration.	W
STANDARDIZE_INTERVAL In Setup TB	Standardize interval is the time in days between standardize due diagnostic messages. Set it as the desired interval between standardizes.	R
TEMP_COMP_REF_TEMP In Setup TB	Reference temperature value for a temperature compensated density measurement.	R
RESERVED_4 In Setup TB	Reserved for density applications.	R
RESERVED_5 In Setup TB	Reserved for density applications.	R
RESERVED_6 In Setup TB	Reserved for density applications.	R
RESERVED_7 In Setup TB	Reserved for density applications.	R
SENSOR_TEMP_COEFF0 In Setup TB	Factory setting for the sensor temperature compensation curve.	R
SENSOR_TEMP_COEFF1 In Setup TB	Factory setting for the sensor temperature compensation curve.	R
SENSOR_TEMP_COEFF2 In Setup TB	Factory setting for the sensor temperature compensation curve.	R
SENSOR_TEMP_COEFF3 In Setup TB	Factory setting for the sensor temperature compensation curve.	R
SENSOR_TEST_MODE In Diagnostics TB	Enable or disable the sensor test mode. If enabled, the sensor counts are specified by the variable PRIMARY_RAW_COUNTS. Choices are: <ul style="list-style-type: none"> <li>Normal mode</li> <li>In test mode</li> </ul>	W
SECONDARY_TEST_MODE In Diagnostics TB	Enable or disable the auxiliary input channel test mode. If enabled, the sensor counts are specified by the variable SECONDARY_COUNTS. Choices are: <ul style="list-style-type: none"> <li>Normal mode</li> <li>In test mode</li> </ul>	W
TEMPERATURE_TEST_MODE In Diagnostics TB	Select the sensor temperature test mode. This allows entry of a specific temperature value (over-riding the measured sensor temperature). Choices are: <ul style="list-style-type: none"> <li>Normal mode</li> <li>In test mode</li> </ul>	W
TEMPERATURE_VALUE In Process and Diagnostics TBs	This variable shows the current temperature reading of the unit sensor electronics.	W

*continued on next page*



Table 19: Transducer block parameters (continued)

Parameter	Description		Mode (R/W)
DIAG_HISTORY_NEWEST_1 In Diagnostics TB	Displays the date of the most recent occurrence of each diagnostic error.		
	Sub-parameter	Description	Mode (R/W)
	DIAG_HISTORY_NEWEST_1	RAM corrupt	R
	DIAG_HISTORY_NEWEST_1	Sensor EEPROM corrupt	R
	DIAG_HISTORY_NEWEST_1	FLASH corrupt	R
	DIAG_HISTORY_NEWEST_1	Real time clock fail	R
	DIAG_HISTORY_NEWEST_1	Sensor temp fail	R
	DIAG_HISTORY_NEWEST_1	Standardize due	R
	DIAG_HISTORY_NEWEST_1	Source wipe due	R
	DIAG_HISTORY_NEWEST_1	New hardware found	R
DIAG_HISTORY_NEWEST_2 In Diagnostics TB	Displays the date of the most recent occurrence of each diagnostic error.		
	Sub-parameter	Description	Mode (R/W)
	DIAG_HISTORY_NEWEST_2	Alarm Type 3	R
	DIAG_HISTORY_NEWEST_2	CPU EEPROM	R
	DIAG_HISTORY_NEWEST_2	Alarm type 1	R
	DIAG_HISTORY_NEWEST_2	Alarm type 2	R
	DIAG_HISTORY_NEWEST_2	Shutter check due	R
	DIAG_HISTORY_NEWEST_2	Sensor fail	R
	DIAG_HISTORY_NEWEST_2	Process out of range	R
	DIAG_HISTORY_NEWEST_2	Sensor voltage out of spec	R
DIAG_HISTORY_OLDEST_1 In Diagnostics TB	Displays date of each of the oldest diagnostic error occurrence.		
	Sub-parameter	Description	Mode (R/W)
	DIAG_HISTORY_OLDEST_1	RAM corrupt	R
	DIAG_HISTORY_OLDEST_1	Sensor EEPROM corrupt	R
	DIAG_HISTORY_OLDEST_1	FLASH corrupt	R
	DIAG_HISTORY_OLDEST_1	Real time clock fail	R
	DIAG_HISTORY_OLDEST_1	Sensor temp fail	R
	DIAG_HISTORY_OLDEST_1	Standardize due	R
	DIAG_HISTORY_OLDEST_1	Source wipe due	R
	DIAG_HISTORY_OLDEST_1	New hardware found	R
DIAG_HISTORY_OLDEST_2 In Diagnostics TB	Displays date of each of the oldest diagnostic error occurrence.		
	Sub-parameter	Description	Mode (R/W)
	DIAG_HISTORY_OLDEST_2	Alarm Type 3	R
	DIAG_HISTORY_OLDEST_2	CPU EEPROM	R
	DIAG_HISTORY_OLDEST_2	Alarm type 1	R
	DIAG_HISTORY_OLDEST_2	Alarm type 2	R
	DIAG_HISTORY_OLDEST_2	Shutter check due	R
	DIAG_HISTORY_OLDEST_2	Sensor fail	R
	DIAG_HISTORY_OLDEST_2	Process out of range	R
	DIAG_HISTORY_OLDEST_2	Sensor voltage out of spec	R
DIAG_HISTORY_RESET In Diagnostics TB	Displays the date of the last diagnostic reset.		W

continued on next page

Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
MAX_SECONDARY_COUNTS In Diagnostics TB	Displays the maximum auxiliary input channel counts recorded since the last reset.	R
MAX_PRIMARY_COUNTS In Diagnostics TB	Displays the maximum sensor counts recorded since the last reset.	R
MAX_SENSOR_TEMP In Diagnostics TB	Displays the maximum sensor counts recorded since the last reset.	R
MIN_SECONDARY_COUNTS In Diagnostics TB	Displays the minimum auxiliary input channel counts recorded since the last reset.	R
MIN_PRIMARY_COUNTS In Diagnostics TB	Displays the minimum sensor counts since the last reset.	R
MIN_SENSOR_TEMP In Diagnostics TB	Displays the minimum unit temperature recorded since the last reset.	R
RESET_MIN_MAX_HISTORY In Diagnostics TB	Sets the min/max history values back to defaults so that new min/max history values can be recorded. The date of the reset is logged to the LAST_RESET variable. Choices are: <ul style="list-style-type: none"> <li>idle</li> <li>execute</li> </ul>	W
STDZ_HISTORY_COUNTS In Diagnostics TB	Displays the counts recorded for each standardization.	
	<b>Sub-parameter</b>	<b>Description</b>
	STDZ_HISTORY_COUNTS	Displays the counts recorded for the standardization.
	STDZ_HISTORY_COUNTS	Displays the counts recorded for the standardization.
	STDZ_HISTORY_COUNTS	Displays the counts recorded for the standardization.
	STDZ_HISTORY_COUNTS	Displays the counts recorded for the standardization.
STDZ_HISTORY_DATE In Diagnostics TB	Provides the date for each standardization occurrence.	
	<b>Sub-parameter</b>	<b>Description</b>
	STDZ_HISTORY_DATE	Displays the date for the standardization.
	STDZ_HISTORY_DATE	Displays the date for the standardization.
	STDZ_HISTORY_DATE	Displays the date for the standardization.
	STDZ_HISTORY_DATE	Displays the date for the standardization.
STDZ_HISTORY_PROCESS In Diagnostics TB	Displays the PV that was specified for each standardization.	
	<b>Sub-parameter</b>	<b>Description</b>
	STDZ_HISTORY_PROCESS	Displays the PV specified for the standardization.
	STDZ_HISTORY_PROCESS	Displays the PV specified for the standardization.
	STDZ_HISTORY_PROCESS	Displays the PV specified for the standardization.
	STDZ_HISTORY_PROCESS	Displays the PV specified for the standardization.

continued on next page

Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
STDZ_HISTORY_GAIN In Diagnostics TB	Provides the calculated gain term for each recorded standardization.	
	<b>Sub-parameter</b>	<b>Description</b>
	STDZ_HISTORY_GAIN	Provides the calculated gain term for the standardization.
	STDZ_HISTORY_GAIN	Provides the calculated gain term for the standardization.
	STDZ_HISTORY_GAIN	Provides the calculated gain term for the standardization.
	STDZ_HISTORY_GAIN	Provides the calculated gain term for the standardization.
	STDZ_HISTORY_GAIN	Provides the calculated gain term for the standardization.
DATA_COLLECT_EXECUTE In Process, Setup, and Diagnostics TBs	Write a non zero value to this variable to force the gauge to average the counts for the data collect interval. Choices are: <ul style="list-style-type: none"> <li>Data collect not active</li> <li>Execute data collect</li> </ul>	W
RESERVED_8 In Diagnostics TB	Reserved for density applications.	R
RESERVED_9 In Diagnostics TB	Reserved for density applications.	R
RESERVED_10 In Diagnostics TB	Reserved for density applications.	R
RESERVED_11 In Diagnostics TB	Reserved for density applications.	R
RESERVED_12 In Diagnostics TB	Reserved for density applications.	R
PEEK_POKE_ADDRESS In Diagnostics TB	Reserved.	R
PEEK_POKE_DATA_TYPE In Diagnostics TB	Reserved.	R
PEEK_POKE_RD_WR In Diagnostics TB	Reserved.	R
PEEK_POKE_FLOAT_VALUE In Diagnostics TB	Reserved.	R
PEEK_POKE_WORD_VALUE In Diagnostics TB	Reserved.	R
PEEK_POKE_BYTE_VALUE In Diagnostics TB	Reserved.	R
PEEK_POKE_EXECUTE In Diagnostics TB	Reserved.	R
SYSTEM_COMMAND In Diagnostics TB	Reserved.	R
FACTORY_KEY In Diagnostics TB	Reserved.	W

*continued on next page*

Table 19: Transducer block parameters (continued)

Parameter	Description	Mode (R/W)
SUPPORTED_MODES In Process, Setup, and Diagnostics TBs	<p>The allowable permitted modes for the block. This is defined in the MODE_BLK, TARGET sub-parameter.</p> <p>Options are:</p> <ul style="list-style-type: none"> <li>• Auto (Normal)</li> <li>• Oos</li> <li>• ROUT</li> <li>• Rcas</li> <li>• Cas</li> <li>• MAN</li> <li>• LO</li> <li>• IMAN</li> </ul>	R
Parameter	Description	Mode (R/W)
HART_INFO In Diagnostics TB	Reserved.	
	Sub-parameter	Description
	HART_COMMAND_ERR_COUNT	Reserved
	HART_COMMUNICATION_ERR_COUNT	Reserved
	HART_COMMAND_ERR_COMMAND	Reserved
	HART_COMMUNICATION_ERR_COMMAND	Reserved
	HART_FUNCTION_ERR_COMMAND	Reserved
	HART_FUNCTION_ERR	Reserved
	HART_COMMUNICATION_ERR	Reserved
	HART_COMMAND_ERR	Reserved
HART_RESET_INFO In Diagnostics TB	Reserved	W

# Appendix IV: Transducer menu and methods interface

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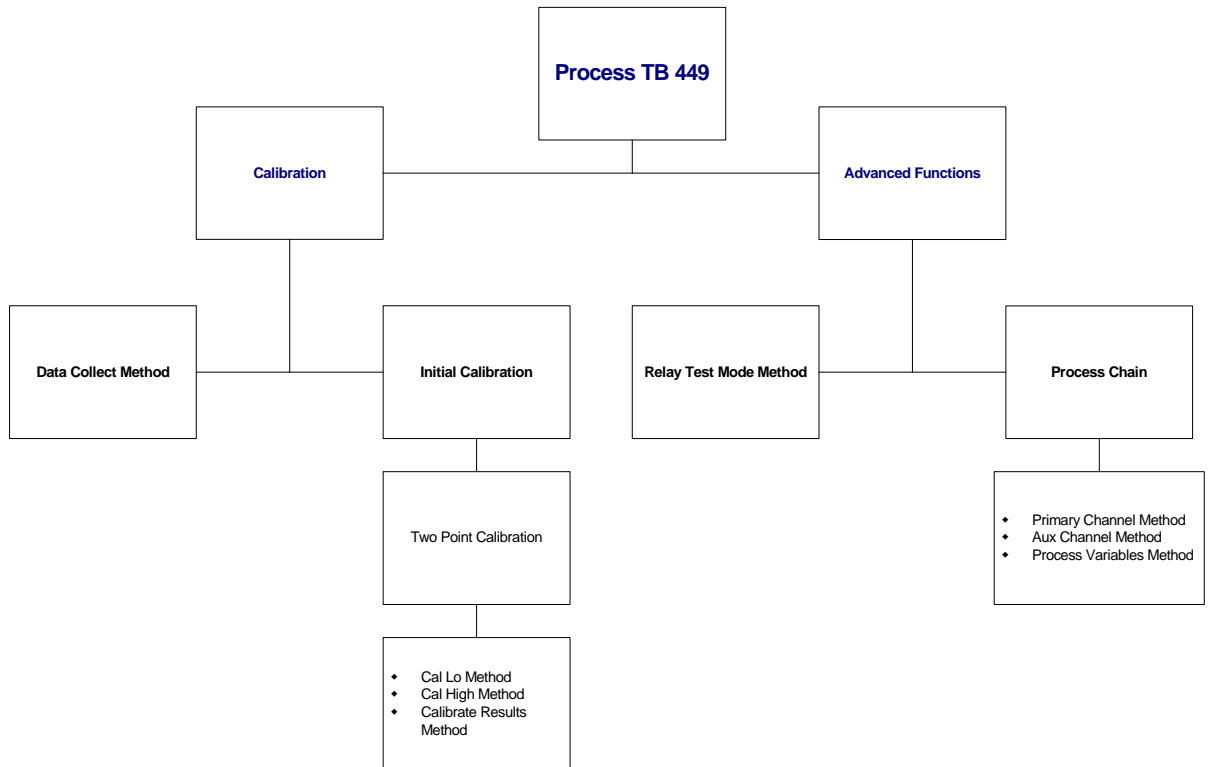
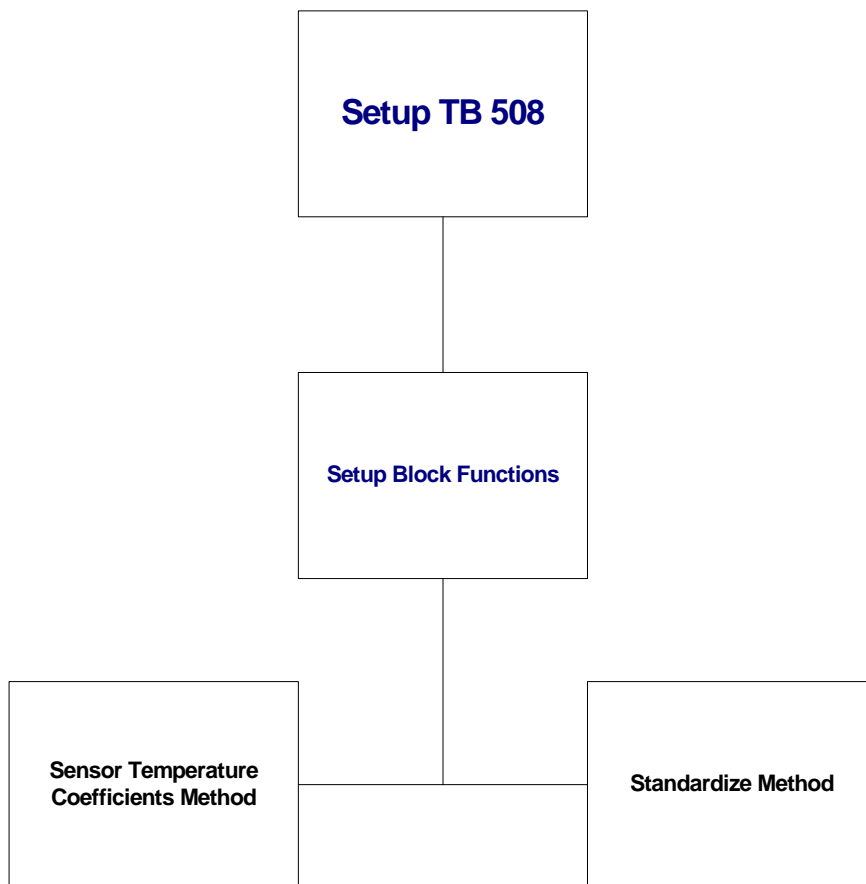


Figure 22: Process transducer block



*Figure 23: Setup transducer block*

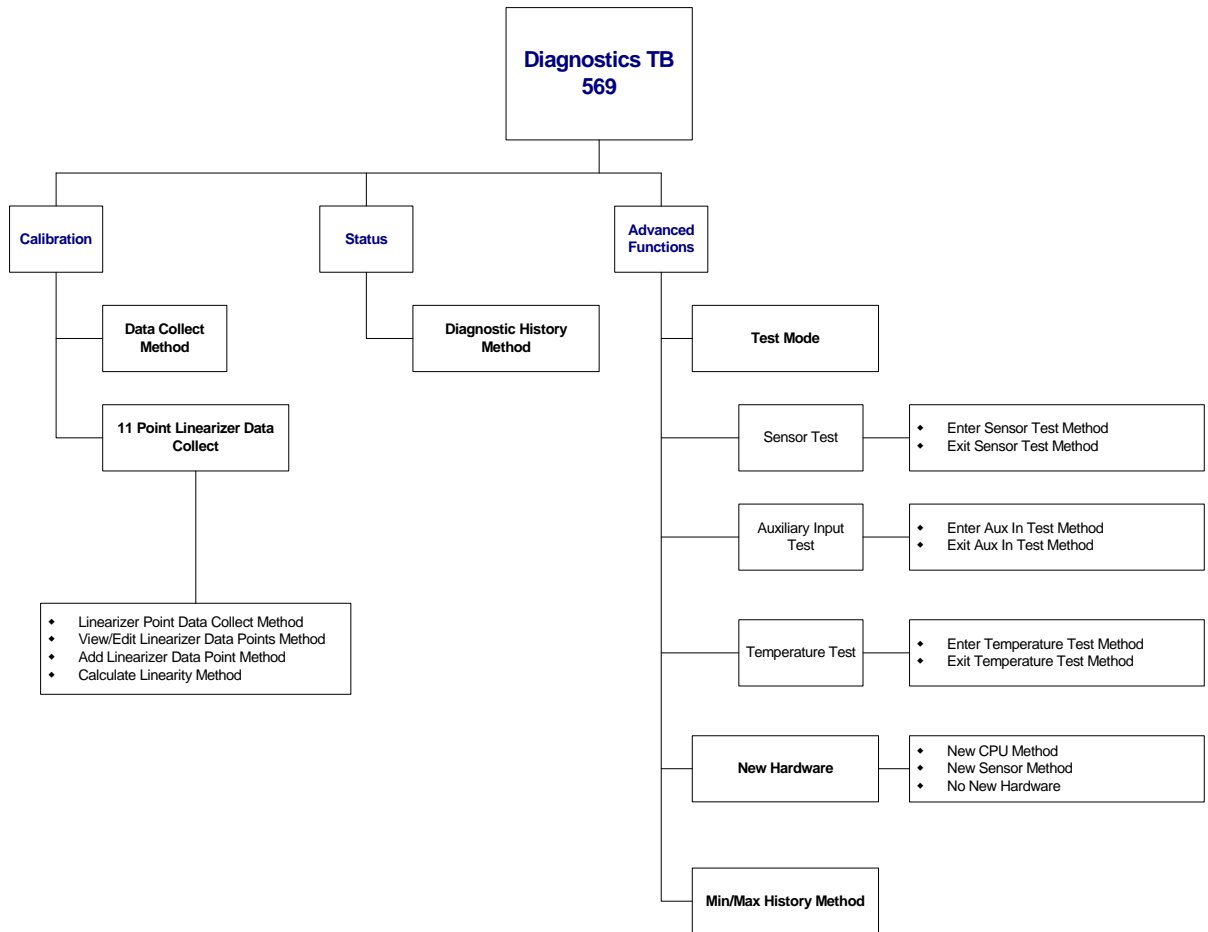


Figure 24: Diagnostics transducer block

Notes



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